THE JOURNAL OF THE LINNEAN SOCIETY.

ZOOLOGY.

VOL. XXV.

LONDON:
SOLD AT THE SOCIETY'S APARTMENTS, BURLINGTON HOUSE,
PICCADILLY, W.,
AND BY
LONGMANS, GREEN, AND CO.,
AND
WILLIAMS AND NORGATE.
1896.

Dates of Publication of the several Numbers included in this Volume.

No.	158, pp.	1–55,	published	October 31, 1894.
„	159–160, „	56–254,	„	December 29, 1894.
„	161, „	255–316,	„	July 31, 1895.
„	162, „	317–338,	„	February 28, 1896.
„	163, „	339–404,	„	July 30, 1896.
„	164, „	405–480,	„	November 5, 1896.
„	165, „	481–622,	„	December 31, 1896.

PRINTED BY TAYLOR AND FRANCIS,
RED LION COURT FLEET STREET.

LIST OF PAPERS.

Page

Allman, Prof. G. J., M.D., F.R.S., F.L.S.
Note on the Formation of the Epiphragm of *Helix aspersa.* (With 1 woodcut.) 517

Ashmead, W. H.
Report upon the Parasitic Hymenoptera of the Island of St. Vincent. (Communicated by David Sharp, M.B., F.R.S., F.L.S.) 56

Bernard, H. M., M.A. (Cantab.), F.L.S., F.Z.S.
On the Spinning-glands in *Phrynus*; with an Account of the so-called "Penis" and of the Morphology of the Operculum. (Plate VIII.) 272

Bingham, Lt.-Col. C. T., F.Z.S., F.E.S.
On some Exotic Fossorial Hymenoptera in the Collection of the British Museum, with Descriptions of New Species and of a New Genus of the *Pompilidæ.* (Communicated by W. F. Kirby, F.L.S.) (Plate XIX.) 422

Bridge, Prof. T. W., D.Sc.
The Mesial Fins of Ganoids and Teleosts. (Communicated by Prof. G. B. Howes, Sec. Linn. Soc.) (Plates XXI.–XXIII.). 530

Burne, R. H., B.A. (Oxon.), Assistant in Museum, Royal College of Surgeons, London.
On the Aortic-Arch System of *Saccobranchus fossilis.* (Communicated by Prof. G. B. Howes, F.L.S.) (With 1 woodcut.) 48

Page

Butler, Arthur G., Ph.D., &c., Senior Assistant-Keeper, Zoological Department, British Museum.
An Account of the Butterflies of the Genus *Charaxes* in the Collection of the British Museum 348

Chapman, F., A.L.S., F.R.M.S., and T. Rupert Jones, F.R.S.
On the Fistulose *Polymorphinæ*, and on the Genus *Ramulina*. (With 9 woodcuts.) 496

Gahan, C. J., M.A., of the British Museum (Natural History).
On the Coleoptera obtained by Dr. Anderson's Collector during Mr. T. Bent's Expedition to the Hadramaut, South Arabia. (Communicated by W. Percy Sladen, Sec. Linn. Soc.) 285

Gilson, Gustave, Professor of Zoology at the University of Louvain.
On Segmentally-disposed Thoracic Glands in the Larvæ of the Trichoptera. (Communicated by Prof. G. B. Howes, Sec. Linn. Soc.) (With 2 woodcuts.) 407

Gilson, Gustave, Professor, and J. Sadones, Assistant, at the Zoological Institute of the University of Louvain.
The Larval Gills of the Odonata. (Communicated by Prof. G. B. Howes, Sec. Linn. Soc.) (With 3 woodcuts.) 413

Howard, L. O.
Report upon the Parasitic Hymenoptera of the Island of St. Vincent. (Communicated by David Sharp, M.B., F.R.S., F.L.S.) 56

Jennings, A. Vaughan, F.L.S., F.G.S., Demonstrator of Botany and Geology in the Royal College of Science, Dublin.
On the True Nature of "*Möbiusispongia parasitica*," Duncan .. 317
On a New Genus of Foraminifera of the Family *Astrorhizidæ*. (Plate X.) 320
On the Structure of the Isopod Genus *Ourozeuktes*, Milne-Edwards. (Plates XIII. & XIV.) 329

Jones, T. Rupert, F.R.S., and F. Chapman, A.L.S., F.R.M.S.
On the Fistulose *Polymorphinæ*, and on the Genus *Ramulina*. (With 42 woodcuts.) 496

Page

KIRBY, W. F., F.L.S., F.E.S.
On the Insects other than Coleoptera obtained by Dr. Anderson's Collector during Mr. T. Bent's Expedition to the Hadramaut, South Arabia 279
Descriptions of New Species of *Forficulidæ* in the Collection of the British Museum (Nat. Hist.), S. Kensington. (Plate XX.). 520

LAURIE, MALCOLM, B.Sc., F.L.S.
On the Morphology of the Pedipalpi. (Plates III.–V., and 7 woodcuts.) 20

MIDDLETON, ROBERT MORTON, Jr., F.L.S., F.Z.S.
On a remarkable use of Ants in Asia Minor 405

POCOCK, R. I., of the British Museum (Natural History).
On the Arachnida and Myriopoda obtained by Dr. Anderson's Collector during Mr. T. Bent's Expedition to the Hadramaut, South Arabia; with a Supplement upon some Scorpions obtained in Egypt and the Eastern Soudan. (Communicated by W. Percy Sladen, Sec. Linn. Soc.) (Plate IX. and a woodcut.) 292
List of the Scorpions obtained by Colonel Yerbury at Aden in the Spring of 1895 316

RILEY, C. V., W. H. ASHMEAD, and L. O. HOWARD.
Report upon the Parasitic Hymenoptera of the Island of St. Vincent. (Communicated by David Sharp, M.B., F.R.S., F.L.S.) 56

SADONES, J., Assistant, and G. GILSON, Professor at the Zoological Institute of the University of Louvain.
The Larval Gills of the Odonata. (Communicated by Prof. G. B. Howes, Sec. Linn. Soc.) (With 3 woodcuts.) 413

SCOURFIELD, D. J.
Entomostraca and the Surface-film of Water. (Communicated by L. C. Miall, F.R.S., F.L.S., Professor of Biology, Yorkshire College, Leeds.) (Plates I. & II.) 1

SWINHOE, Colonel CHARLES, F.L.S., F.Z.S..
On Mimicry in Butterflies of the Genus *Hypolimnas*. (Plates XV.–XVII.) 339

Page.

Tims, H. W. Marett, M.D., F.Z.S., Lecturer on Biology and Comparative Anatomy, Westminster Hospital Medical School.
On the Tooth-genesis in the *Canidæ*. (From the Huxley Research Laboratory, Royal College of Science, London.) (Communicated by Prof. G. B. Howes, Sec. Linn. Soc.) (With 8 woodcuts.) 445

Waite, Edgar R., F.L.S., Zoologist, Australian Museum, Sydney.
On the Egg-cases of some Port Jackson Sharks. (Plate XII.) 325

Wallace, Alfred R., LL.D., F.R.S., F.L.S.
The Problem of Utility: Are Specific Characters always or generally Useful? 481

Waters, Arthur Wm., F.L.S.
On Mediterranean and New-Zealand *Reteporæ* and a Fenestrate Bryozoa. (Plates VI. & VII.) 255

West, G. S., A.R.C.S., Scholar of St. John's College, Cambridge. (From the Biological Laboratory, Roy. Coll. Sci. London.)
On a New Species of *Distomum*. (Communicated by Prof. G. B. Howes, Sec. Linn. Soc.) (Plate XI.) 322
On two little-known Opisthoglyphous Snakes. (Communicated by Prof. G. B. Howes, Sec. Linn. Soc.) (Plate XVIII.).... 419

EXPLANATION OF THE PLATES.

PLATE

I. II. SCAPHOLEBERIS MUCRONATA. NOTODROMAS MONACHA. Illustrating Mr. D. J. Scourfield's paper on Entomostraca and the Surface-film of Water.

III. IV. V. MORPHOLOGY OF THE PEDIPALPI. Illustrating Mr. Malcolm Laurie's paper.

VI. VII. MEDITERRANEAN RETEPORÆ. MEDITERRANEAN AND NEW ZEALAND RETEPORÆ. Illustrating Mr. A. W. Waters's paper.

VIII. SPINNING-GLANDS IN PHRYNUS. Illustrating Mr. H. M. Bernard's paper.

IX. SCORPIONS OF EGYPT AND ARABIA. Illustrating Mr. R. I. Pocock's paper.

X. RHAPHIDOSCENE CONICA on *Botellina labyrinthica*. Illustrating Mr. A. Vaughan Jennings's paper on a new Genus of Foraminifera of the Family Astrorhizidæ.

XI. ANATOMY of *Distomum Philodryadum*, n. sp., G. S. West. Illustrating Mr. G. S. West's paper on a new species of *Distomum*.

XII. EGG-CASES OF CESTRACION—*C. Philippi*, Schneider, *C. galeatus*, Günther. Illustrating Mr. E. R. Waite's paper on the Egg-cases of Port Jackson Sharks.

XIII. XIV. OUROZEUKTES OWENII, Milne-Edwards. External Form of Adult and Larva, appendages, &c. Illustrating Mr. A. Vaughan Jennings's paper on the Structure of the Isopod Genus *Ourozeuktes*.

XV. XVI. XVII. Illustrating Colonel C. Swinhoe's paper on MIMICRY IN BUTTERFLIES of the Genus *Hypolimnas*.

XVIII. ERYTHROLAMPRUS ÆSCULAPII. Illustrating Mr. G. S. West's paper on Opisthoglyphous Snakes.

XIX. Illustrating Lt.-Col. C. T. Bingham's paper on EXOTIC FOSSORIAL HYMENOPTERA.

XX. Illustrating Mr. W. F. Kirby's paper on New and little-known FORFICULIDÆ.

XXI. XXII. XXIII. Illustrating Prof. T. W. Bridge's paper on the MESIAL FINS OF GANOIDS AND TELEOSTS.

ERRATA.

Page 198, line 3 from bottom, ⎫
,, 199, line 14 from top, ⎬ *Ceraphron fummipennis*, Ashm., read *C. fumipennis*, Ashm.
,, 200, line 3 from top, ⎭

,, 282, line 9, *Dectisus vittatus*, Klug, read *Decticus vittatus*, Klug.

,, 343, line 22, *Hypolimnas mina*, read *H. mima*, Trimen.

,, 375, line 10, *Charaxes pithodoris*, Hewits., Ent. M. M. &c., read *C. pythodoris*, Hewits., &c.

,, 375, line 11, *Charaxes pithodoris*, Hewits., substitute *C. pithodoris*, Hewits. Exot. Butt. v. *Charaxes*, pl. iv. figs. 18, 19 (1874).

,, 375, line 12, read *C. pythodorus*, Kirby, &c., p. 748 (*not* p. 478).

,, 432, line 20, for *Hemepepsis* read *Hemipepsis*.

,, 477, line 3, for *Micoconodon* read *Microconodon*.

THE JOURNAL

OF

THE LINNEAN SOCIETY.

Entomostraca and the Surface-film of Water. By D. J. Scourfield. (Communicated by L. C. Miall, F.R.S., F.L.S., Professor of Biology, Yorkshire College, Leeds.)

[Read 1st March, 1894.]

(Plates I. & II.)

Although it has long been recognised that the curious physical properties possessed by the surface-film of water render it of considerable importance to many of the smaller aquatic animals, the question of the specific relation of these creatures to the surface-film seems to have been somewhat neglected by naturalists. Many observations have of course been recorded and some valuable suggestions made in this connection, notably those by Prof. L. C. Miall, F.R.S., in his Lectures on "Some Difficulties in the Life of Aquatic Insects" and on "The Surface-film of Water and its relation to the Life of Plants and Animals"*; but nothing that has yet been done can be considered to have exhausted the subject. On the contrary, it is quite certain that a large amount of observational work is still required among all classes of aquatic Invertebrates; and it is mainly as a small contribution towards this end that the following notes and deductions concerning the freshwater Entomostraca are now brought forward. Notwithstanding the necessary in-

* Reported in 'Nature,' vol. xliv. p. 457, and vol. xlvi. p. 7.

clusion of special details and the tentative nature of some of the ideas advanced, it is hoped that the present paper will prove, on the whole, of some general interest.

Neglecting the Phyllopods, which have not been specially studied, and the Copepods, which will be referred to later, the remaining Entomostraca—Cladocera and Ostracoda—present so much in common from the point of view of relation to the surface-film, that it will be convenient to consider them together. For instance, to a large number of animals belonging to both these Orders the surface-film is an ever-present source of danger. It must have been noticed by all collectors of pond-life that whenever a gathering is made containing an abundance of these forms, in a very short time a number of them will be found floating on their sides at the surface in a helpless condition, apparently quite incapable of getting back into the water by their own exertions. From observations made on isolated specimens it appears that the main chance such animals have of regaining their normal habitat lies in moulting. If this be possible to the animals shortly after their misadventure, they can slip back into the water, leaving their cast carapaces still floating at the surface. But if they are not nearly ready to moult, and are also unable to get back by other means, such as violent disturbance of the surface by the wind, for example, it need hardly be pointed out that such an unnatural position can only mean a more or less speedy death. The chief sufferers in this respect, so far as my observations go, seem to be species of the genera *Daphnia*, *Ceriodaphnia*, *Simocephalus*, *Bosmina*, *Eurycercus*, and *Acroperus* among the Cladocera, and of *Cypria*, *Cypris*, and *Herpetocypris* among the Ostracoda, although others also may sometimes be found in this unfortunate state. Judging from the usual paucity of these floating forms on the surface of open waters, it seems probable, however, that, under natural conditions, only a comparatively few lives are sacrificed in this way. But on this point more extended inquiry is necessary before a definite statement can be made. That an enormous number of Water-fleas may occasionally perish from this cause, is clearly shown by the following instance:—During the last summer *Daphnia Schæfferi*, Baird, occurred in astonishing abundance in the London Docks, and when I visited the latter in July there was a dark red scum, composed entirely of these animals, forming a border from 1 to 2 feet in width along the quays, around the

ships, &c., and even forming patches of many square yards in the narrow channels connecting the "basins."

Whatever its ultimate value may be found to be as an element in the life-histories of the various species, the means by which this helpless floating at the surface is brought about is well worth examination. That it cannot depend upon any single circumstance seems probable from the following considerations :—(1) The animals, although small, have a decidedly greater specific gravity than water, as can be seen by the way in which they sink upon the stopping of their swimming-organs when not in contact with the surface ; (2) they are completely immersed before the floating takes place ; and (3) they possess considerable muscular energy, which, if it were not counteracted by other circumstances, would probably take them quickly below the surface. It will be found, I believe, that there are several factors contributing in varying degrees to the observed result. In the first place, the animals subject to this undesirable connection with the surface-film have highly-polished water-repellent shells. This can be directly seen by an examination of floating specimens, and can be further verified by experiment. For instance, if a fair-sized *Daphnia* or *Eurycercus* or *Cypris*, that has been floating, be placed upon a glass slip with a small drop of water, it will be found that a narrow pointed strip of blotting-paper may be applied to the upperside of the animal without getting wet. Under similar conditions, bodies not possessing water-repellent surfaces would have a film of water passing completely over them, and the blotting-paper would therefore draw up a continuous stream. Secondly, it is a well-known fact that when a substance is partly immersed in a liquid which cannot wet it, the surface-film of the liquid is drawn downwards at the line of contact to form a descending capillary curve. The effect of this, as explained in most text-books of physics, is that the surface-film exerts an upward pull upon the body against which the descending capillary curve is formed. By putting these two points together, the first and most important step in the explanation of the floating of these Entomostraca may be made. On the one hand, there are the animals with water-repellent shells, and, on the other, the property of the surface-film to form a capillary depression when in contact with water-repellent substances. The process, therefore, must be as follows :—When an Entomostracan having one of these waterproof jackets happens to pierce the surface-film, a capillary

depression is at once formed of such size that it is at least sufficient to sustain the difference in weight between the animal's body and water. In the case of large specimens, the capillary depression can be readily seen with a pocket-lens. In the case of very small forms, e. g. *Bosmina*, it is proved to exist by the way in which they are repelled from a clean glass rod or tube; for it is a familiar fact that while similar capillary curves attract, dissimilar ones repel one another, and the capillary curve formed against glass is of course an ascending one. A very simple experiment may be made which illustrates the whole action on a scale large enough to be watched by ordinary vision. If a lenticular piece of some such water-repellent substance as paraffin-wax be taken, say, about 2 inches in diameter, and weighted until slightly heavier than water, it will be found that as soon as one of its convex faces is pressed from below against the surface-film, the latter rapidly retreats down the sloping sides, producing a large capillary depression, and that the wax then remains suspended from the surface. When it is remembered that, owing to the small size of the Water-fleas, their area, compared with that of the piece of wax, must be enormously greater in proportion to their bulk, it will be seen that the suspending power of the surface-film must also be comparatively greater in their case; for, other things being equal, the force exerted by the surface-film is proportional to the length of the line of contact.

There are two other factors which, although they do not help in the actual floating, are of considerable importance, because together they account very largely for the inability of the animals to get below the surface when once caught by the film. One of these is the tendency which they have, in common with all floating bodies of approximately lenticular shape, to take up a horizontal position, that being their only position of stable equilibrium; and the other, the situation and range of movement of their swimming-organs. The tendency to turn upon their sides is obscured occasionally in consequence of a more or less considerable departure from the lenticular form, or by the possession of wide-spreading antennæ; but it remains true, nevertheless, that in the great majority of cases the animals are actually found floating in this position. It will readily be seen that, when thus floating on their sides, the Cladocera lose the use of one of their swimming-antennæ altogether, it is out of the water, and that both Cladocera

and Ostracoda are quite incapable of opposing the upward pull of the capillary depression. The utmost they can do is to move about horizontally at the surface.

There are probably still further factors concerned in the floating, such as the amount of convexity of the shell and its degree of water-repulsion; but these seem only of minor importance, and need not be dealt with here.

Thus far only the danger to which many of the Cladocera and Ostracoda are exposed when accidentally coming into contact with the surface-film has been considered. Attention must now be directed, however, to some cases in which the peculiar properties of the latter have been so utilised as to play quite a normal part in the economy of the animals concerned. It is impossible to say at present to what extent this utilisation prevails, as very few species have been properly examined from this stand-point. The only genuine cases known to me, where special modifications exist adapting the animals for a life in contact with the surface-film, are to be found in the genera *Scapholeberis* among the Cladocera, and *Notodromas* (including the Australian *Newnhamia*, King) among the Ostracoda. I have, it is true, seen species belonging to other genera, e. g. *Simocephalus vetulus*, O. F. M., and *Peracantha truncata*, O. F. M., apparently suspended from the surface; but it seems doubtful if these forms actually make use of the properties of the surface-film; at any rate, they do not present any evident modifications for that purpose. In the British Isles there is but a single representative of each of the two genera mentioned, namely, *Scapholeberis mucronata*, O. F. M. (*Daphnia mucronata*, Baird), and *Notodromas monacha*, O. F. M. (*Cypris monacha*, Baird). These forms, notwithstanding their wide structural differences, have several points in common, correlated, no doubt, with a similar mode of life. But these resemblances will be best appreciated when each species is examined separately in some detail.

Taking, first, *Scapholeberis mucronata*, including both the "acute" and "obtuse rostrata" varieties, it will be seen (Pl. I. figs. 1 and 2) that the most conspicuous of its characteristics are the flattened and straight ventral margin, the two long posterior ventral shell-spines, the elevated position of the eye, the remarkable dark coloration of the shell, and the no less remarkable series of modified setæ on the ventral portions of the valves. Each of these characteristics has doubtless some significance in connection

with the subject in hand, but only the two last seem to demand special consideration.

A cursory examination will show that the dark colour alluded to is not distributed uniformly over the whole body, but that it occurs in definite patches. Viewed from the side (Pl. I. fig. 1) there appears a small patch on the ventral face of the head between the eye and the rostrum, another patch covering the ventral third of the valves, which, although not quite reaching the posterior margin, extends into the shell-spines, and a fainter patch along the dorsal line of the body. The small antennæ and the ventral surfaces of all the joints of the large antennæ, together with the pre-anal portion of the post-abdomen, are also evidently darkened. The front or vental view (Pl. I. fig. 2) shows all the above mentioned areas, necessarily with the exception of the dorsal one; and besides revealing the fact that the labrum is also considerably blackened, it proves that the ventral patches of colour are even larger than appeared from the side. A curious little fact may be pointed out in passing, in relation to the patch on the head, namely, that the colour is absent just over the small eye-spot. This seems to show that the latter is really a functional visual organ. The colour in all cases is produced in part by a staining of the chitin, proved by the fact that the moulted shell and appendages retain the characteristic dark areas, and in part by a number of ovoid pigment granules contained in the cells immediately underlying the chitinous integument. These granules are distributed, it is true, all over the surface of the body, but only sparingly in the uncoloured portions, while under the darkened areas they are very abundant. Their colour is not quite black, but rather a dark brown; and this is also the case with the darkened portions of the carapace and appendages. The physiological cause of these peculiar colour-markings is, so far as I am aware, quite unknown. Their probable utility will be seen, however, when the habits of the animal are considered in a later part of this paper.

Passing now to an examination of the setæ fringing the ventral margins of the valves, it will be found that, when looked at from the side (Pl. I. fig. 3), the anterior and posterior members of the series are both longer and coarser than those in the middle. The anterior ones can also be seen to have a small branch directed forward. But beyond this, and the fact that with dark-ground illumination there is an appearance which suggests that an

extremely delicate membrane or series of hyaline scales is supported by the setæ, very little more can be made out by examination in this position. To really learn anything of the structure and arrangement of the setæ, they must be viewed from the front, and even then, owing to the thickness and dark colour of the animal, special care is needed to demonstrate the finer details. The setæ arise from a definite flattened area running down the greater portion of the margin of each valve (Pl. II. fig. 1). This area, which is bounded by the edge of the valve and a slight ridge almost parallel to it, represents, no doubt, an original line of hexagonal shell-markings similar to those covering the general surface of the valves. The setæ, it will be noticed, are not alike all the way down, but are divided into three distinct series.

The anterior series (Pl. II. fig. 2) usually comprises about twelve apparently tubular setæ arranged in a single row. The line of their bases occupies a median position on the flattened area for the posterior half of its length; but anteriorly it curves towards the edge of the valve. The first few setæ are directed forward, and at the same time are strongly curved inward; but as the series is followed backward the amount of this curvature decreases, and the general direction of the setæ is also gradually changed, so that those of the posterior half of the series come to point outward. From the base of all except the first two or three setæ, a branch is given off which turns in the opposite direction to that pursued by the main branch; and in nearly all cases each of the branches further gives rise to a little subsidiary outgrowth directed forward. It sometimes happens that the inner branch is widely separated from the other at the base, and then the anterior series practically consists of a double row for a large portion of its length. The last seta is, however, always single, and possesses a short peduncle anterior to its bifurcation. Besides the coarser branching, each seta produces near its distal extremity, and the last also along its posterior margin, a number of exceedingly fine processes, which are usually grouped in bundles of three or four. They can be most easily observed on the last seta (Pl. I. fig. 4); and in this case also a slight break in the edge of the seta can occasionally be seen at their point of origin. From their excessive delicacy it is still uncertain whether these are simple hair-like outgrowths or only corrugations in a hyaline membrane supported by the setæ.

There is yet another point to be noticed in connection with this anterior series of setæ. At some distance beyond the outer branches an excessively faint marking may be seen (see Pl. II. fig. 2) running parallel to a line joining their tips, and consisting of short closely-set lines. I believe this marking is really the outer edge or fringe, so to speak, of a number of imbricated hyaline scales supported by the setæ. This is a point, however, that has not been clearly demonstrated; and the supposition is based mainly upon comparison with the more evident scales found in connection with the middle series of setæ.

In the middle series there is always a distinctly double row of comparatively short and nearly straight setæ, pointing approximately backward, the setæ of the inner line inclining somewhat inward, and those of the outer line outward. They are arranged in pairs, of which there are about twenty; and the bases of the setæ of each pair are joined by a faint ridge. Where the setæ of the inner line project beyond the edge of the valve, they can be seen to support a series of very delicate slightly overlapping scales, the edges of which, under high magnification, have a similar appearance to that noticed just beyond the tips of the setæ of the anterior series. A view of three of these scales is shown on Pl. II. fig. 3. Analogy would lead one to suppose that similar scales would be found supported by the outer line of setæ; and such is actually the case, but these cannot be so readily observed. Probably also the scales of each pair of setæ join in the middle, although this has not hitherto been certainly proved.

The posterior series usually comprises only two setæ, pointing backward, of which the anterior one is bifurcated and the other simple. They are longer than those of the preceding series, but give rise apparently to hyaline scales of identical structure.

Before leaving this subject of the modified ventral setæ, it must be stated that in the male there is only a single row down the whole length of each valve. The setæ are essentially the same in their coarser structure; but they seem to be simply plumose instead of giving rise to hyaline scales. This appearance may nevertheless be produced by a much greater fringing of the edges of the scales than is the case in the female. If not, these male setæ evidently represent a stage in the evolution of the more complicated structures already described.

From the foregoing description, especially of the setæ fringing

the ventral margin of each valve, it becomes clear that *Scapholeberis* exhibits very considerable specialisation, and the question naturally arises as to the meaning of the latter. To answer this, attention must be turned to the living animals and their peculiar mode of existence in relation to the surface-film. By watching them in their native ponds, it may be seen, with a little patience, that they have the habit of disporting themselves quite close to the surface, especially in sunny weather; and this fact has been noticed and recorded by many observers. But something more than this seems necessary to justify the elaborate modifications described; and it is therefore particularly fortunate that by very simple means a most intimate connection with the surface-film can be demonstrated. If a single individual be isolated, say, in a watch-glass, and carefully observed, it will be found sooner or later to come up and apply its straight ventral margin close to the underside of the surface-film. In this position it will usually continue to move about more or less rapidly for considerable periods, very often, in fact, until purposely disturbed, when it will at once dive below the surface. Occasionally, when conditions are favourable, the animal may even be seen to remain motionless at the surface, with its swimming-antennæ held rigidly almost at right angles to the body (Pl. I. fig. 2). But what does this mean? Since the animal is heavier than water, it can only mean that the difference in weight between the animal's body and water is borne by the surface-film, and this again further implies the existence of a capillary depression. Such depression can be actually seen if looked for in the following way:—Place the watch-glass containing the specimen in such a position that the light from a lamp or window falls upon the surface of the water at an angle anywhere between 20° and 30° with the horizontal. If the eye, aided by a lens or low power of the microscope, be now placed in the path of the reflected rays, the surface will appear like a sheet of polished silver, upon which the smallest speck of dust or break in continuity can be instantly detected. Now whenever the animal comes into contact with the surface-film, it will be found that there is a very evident break, or rather several breaks, produced in the continuity of the surface-film. Further, these breaks will be found to persist as long as the contact is maintained, no matter whether the animal be actively moving about or stationary. It is not pretended that these minute irregularities in the surface-film can be

readily made out to be capillary depressions. They must, however, be either depressions or elevations; and since it is impossible to imagine how the latter could sustain a weight, the conclusion is inevitable that the irregularities seen are actually depressions. But how can capillary depressions be formed by such a small body coming from beneath the surface? So far as I am aware, there is only one way in which a capillary depression can be formed under these conditions, and that is by the piercing of the surface-film by a more or less water-repellent substance. By making the assumptions, therefore, that the minute chitinous ventral setæ and scales are water-repellent, and that they can be forced through the surface-film by the muscular power of the animal, neither of which can be considered a very large assumption, it is manifest that a tolerably clear general notion may be formed of the means by which *Scapholeberis* makes use of the surface-film. The water-repellent scales and setæ, pushed through the film, give rise to a number of capillary depressions (apparently four, produced, I believe, by the anterior and posterior groups of ventral setæ) which are large enough to support the animal, but not too large to prevent it from breaking contact with the surface and retreating below when required. While the principles involved are thus essentially the same as in the case of the helplessly floating forms already referred to, in this instance they are turned to good account by means of special organs of limited extent, the whole arrangement being under the control of the animal.

Coming now to *Notodromas monacha* (Pl. I. figs. 6 and 7) it will be noticed that, from the present point of view, its chief characteristics are the dark coloration of parts of the shell-valves, and their flattened ventral surfaces. These, it will be seen, are precisely analogous characters to those specially noted in *Scapholeberis*.

The colour, although not so arranged as in the Cladoceran, is nevertheless distributed in patches in a very definite manner. On each valve there is a practically continuous band of varying intensity stretching diagonally from the upper part of the anterior margin to near the posterior end of the ventral margin, from whence it turns forward and forms a band along the greater part of the edge of the valve, covering very nearly the whole of the flattened area. Two little isolated patches of colour also usually occur between the principal diagonal band and the pos-

terior margin, just below the median line. It is quite clear, from the arrangement described, that in spite of the approach of a part of the coloration to the dorsal surface anteriorly, the bulk of it is, as in *Scapholeberis*, markedly within the ventral half of the shell. I have not noticed an actual staining of the chitin in this case, but the colour-patches are due to an enormous number of minute dark brown granules closely packed within the cells lying just under the shell, and the hexagonal shape of these cells accounts for the zigzag edge of the darkened areas.

The second point to be detailed in relation to this animal, namely, the flattened ventral margin, is very peculiar and deserves careful attention. Examined from the side nothing can be seen but a perfectly straight edge giving rise to a few slender setæ, but looked at from below it becomes evident at once that this ventral portion of the shell is very much specialised (Pl. II. fig. 4). The main features, as seen when the valves are closed, are thus well described by Prof. G. S. Brady, F.R.S., in his "Monograph of the Recent British Ostracoda" *:—"The ventral surface is bounded by two conspicuous elevated arcuate ridges, one on each valve, which together enclose a flattened lozenge-shaped area. Parallel to the contact-margin of each valve runs another straight but much less conspicuous ridge, which, towards the front, curves outward and joins the external ridge at an acute angle, the union of the two forming a slight elevation, from which a single ridge runs forward, gradually merging in the flattened encircling flange of the anterior border." This account is given in connection with the male, but the arrangement is the same in both sexes, the only difference being that the modified area is comparatively larger in the female than in the male. In addition to the two chitinous ridges, there are also, on the ventral portion of each valve, some lines of simple setæ. By far the longest of these is the one running quite close to and parallel with the inner ridge on its outer side. The others are found in the somewhat semicircular depression formed by the bending of the inner to join the outer ridge, which depression, by the way, is most strikingly similar, both in position and shape, to that found on the anterior part of the shell-valves of *Scapholeberis*.

The habits of *Notodromas* are almost identical with those of

* Transactions of the Linnean Society, vol. xxvi. 1868.

Scapholeberis, at least in so far as they relate to the surface-film, and many authors have long since recorded that animals belonging to this genus often swim about just under the surface. I have myself seen groups of *N. monacha*, in a quiet stream, moving about close under the surface, much in the same way as groups of Whirligig-beetles move about on the surface, though more leisurely. But observations of this sort are not sufficient to reveal much about the exact relation of this species to the surface-film and the specific action of its modified ventral area with the curious ridges. For this purpose the same methods must be used as in the previous case. Close attention to the movements of an isolated specimen will show that although it swims nearly vertically, the moment it touches the surface it assumes a horizontal position, back downwards, thus bringing its straight ventral margin into close contact with the surface-film. This action is obviously precisely similar to that already noticed in *Scapholeberis*. In this position the animal may continue to move about for an indefinite period, usually rather briskly, but sometimes so leisurely that no doubt is left in the observer's mind that the weight of its body is actually supported by the surface-film. To make as sure as possible of this point, the surface can be examined with the reflected beam of light as already described, and then it will be found that little irregularities are formed whenever the animal comes to the surface, and that these last as long as contact is maintained. There are usually three such to be seen—two lateral ones anteriorly, and a median one some distance farther back. Here, again, there can be no reasonable doubt that these little irregularities are really capillary depressions, and that they also must owe their origin to the piercing of the surface-film by the ventral ridges, or rather perhaps only the anterior parts of them, and by the extremities of a pair of feet or the caudal rami. The two assumptions that these parts are water-repellent and that they can be pushed through the surface-film are as necessary here to complete the argument as in the case of *Scapholeberis*, although in regard to the first it may be noted that the general surface of the shell of *Notodromas* can be easily shown to be water-repellent, and this of course greatly increases the probability that the same is true of the ridges.

It is not to be imagined that the explanation just given of the means by which the surface-film is utilised, clears up all the

curious problems that suggest themselves in connection with the modifications of the two forms described. No certain answer can be given, for instance, as to the reason for the division of the ventral setæ in *Scapholeberis mucronata* into three sections, or about the function of its shell-spines, although it is almost certain that they are both related in some way or another to the animal's peculiar habits. Again, there is the strange rectangular plate projecting from the posterior end of the ventral margin of the left valve in *Notodromas monacha*; while it seems probable enough that this plate also is related to the use made by the animal of the surface-film, nothing is definitely known about it at present.

Leaving these and similar queries, it will be useful to turn to a consideration of the benefits derived from a close connection with the surface. The most important of these are certainly the support afforded, the probable abundant food-material obtained, and the easiness of respiration. The first is very evident, for, owing to the greater specific gravity of these animals than water, a large amount of muscular effort is required to enable them to maintain themselves at any particular level, apart altogether from making onward or upward progress, and this will naturally be entirely saved by suspension from the surface. In regard to the food-supply, two questions arise which need answering before any special indebtedness of the animals to the surface-film on this account can be demonstrated:—(1) Can particles of food floating on the surface be appropriated? and (2) What is the extent to which such particles occur in that position? The first question can be answered in the affirmative without hesitation. If a little finely-divided material, such as flour, be lightly dusted upon the water, it can be seen, if the animals are watched under the microscope when they come to the surface, that the floating granules are taken between the shell-valves in a continuous stream owing to the current produced by the branchial appendages; and from this stream any particles suitable for food would evidently be picked out in the usual way. The second question is not quite so easily answered. Direct observation does indeed show that a number of small fragments of all descriptions can actually be seen upon the surface of all open waters, especially near their margins, but these would only be available for food to a very small extent by the animals under review, which no doubt depend much more largely upon particles so minute as to be

practically invisible to the naked eye. That such minute particles also occur upon the surface of ponds and ditches &c. is, however, rendered fairly certain by the fact that in all situations there is known to be a continuous rain of fine dust, a proportion of which is always organic in origin. There is another source of surface-food particles which must be mentioned, although its value in this case is unknown. Some Bacteria in the zooglœa state often form extensive patches on still surfaces, and these frequently afford a sort of rendezvous for numerous small forms of life such as Rhizopods and Infusoria. On the whole, it seems reasonable to suppose that the surface-film does supply these animals with abundant and varied food-material, for which, too (and this, after all, is the crucial point), there is, so far as is yet known, very little competition. It has occurred to me that this peculiar power of obtaining food from the surface may largely explain why these animals are never seen far from the shore. From their structure it might be supposed that they could live equally well at any part of the surface of a piece of water, no matter how large, and so probably they could if food were equally abundant in all parts. But, owing to the surface-drift produced by movements of the air, the middle portions of the area of even small ponds, if not too much sheltered, are always much cleaner than the marginal portions. The third advantage mentioned, namely the comparative easiness of respiration, following as it does directly from the perfect aeration of the surface-water, demands no special comment.

As a contrast to the foregoing advantages, it should be remarked that there seems to be one very probable disadvantage attaching to this mode of life. It can scarcely be doubted that the animals using the surface-film for the purpose of support are much exposed to the attacks of predaceous insects living upon the surface, such as the Whirligig-beetles (*Gyrinus*). Unfortunately no positive proof of this has yet been obtained. If, however, this view is subsequently substantiated, as seems probable enough, the remarkable darkening of these creatures on and near the ventral surface could then be interpreted as an example of protective coloration, for it can be readily observed that their dark colour renders them very inconspicuous in their normal habitats, when seen from above.

In addition to the several characters in common already given, there is one other which merits a passing notice, depending, as it probably does, largely upon the similar habits of the two species under consideration. It has been observed that in this country both are to be found only during the warmer half of the year *. This is not a very striking fact in the case of *Scapholeberis*, because such a limitation of the period of activity is the rule rather than otherwise among the Cladocera; but it is more noticeable with *Notodromas*, as the Ostracoda do not furnish many other examples of periodicity, and even such occur apparently in the colder, rather than in the warmer, part of the year. It will readily be seen that the periodicity found to exist is very advantageous in both these particular cases, for the power the animals possess of attaching themselves to the surface-film would be nearly useless during most of the winter, owing either to the ice or to the comparatively disturbed state of the surface of the water when not frozen.

The surface-utilising habit is so very peculiar and so strangely limited among the Cladocera and Ostracoda, that any evidence relative to its origin would possess more than ordinary interest. Possibly nothing definite will ever be known about the stages of its evolution, but certain suggestions may be made which seem to throw a little light upon the matter, or at any rate to considerably narrow the problem. In the first place, it appears almost certain that the habit did not arise under marine conditions, because a nearly smooth water-surface is an essential, even now, for its exhibition. Secondly, it is tolerably certain that of freshwater forms only those having approximately straight ventral margins could have been able, in the first instance, to use the surface-film to advantage. This, coupled with the fact that both *Scapholeberis* and *Notodromas* can attach themselves to the sides of a glass vessel with their ventral margins towards the glass, leads me to think that the forms from which the present species have been derived were in the habit of crawling over the surfaces of weeds, &c., much as *Graptoleberis testudinaria*, Fischer, does now, and had been modified in the same direction.

* See Baird's 'Natural History of the British Entomostraca,' pp. 100 and 154. Also the author's paper on "The Entomostraca of Wanstead Park," in the Journal of the Quekett Microscopical Club, ser. 2, vol. v. p. 165.

This assumption is perhaps less necessary in the case of *Notodromas* because of the general prevalence of a nearly straight ventral margin among the Ostracoda, but it is essential for *Scapholeberis*. Thirdly, of freshwater forms having nearly straight ventral margins, only those Cladocera accustomed to swim in a somewhat reversed position, and those Ostracoda swimming in the same way, or at least vertically, could, it would seem, have taken advantage of the surface-film by means of their ventral shell-margins.

There is only one other point that need be mentioned before leaving this part of the subject. It has been pointed out in a previous part of the paper that to many of the Cladocera the surface-film is a source of danger; yet to these very same forms there is one indirect way in which the surface-film is probably beneficial, not perhaps to individuals, but to the species. The envelopes of the ephippial or resting eggs of these creatures possess the same water-repellent power characteristic of the carapaces from which they are developed, and in virtue of this they are often found floating on the surface, although really of greater density than water. By this means their dispersal must be greatly facilitated, and their transmission from pond to pond rendered possible, even without the drying-up of the particular pieces of water in which they are produced.

The relation of the Copepoda to the surface-film of water is all that now remains to be considered. The first fact that presents itself in this connection is that never by any chance can an animal belonging to the freshwater division of this order be found floating on the surface in the helpless condition common among the Cladocera and Ostracoda. This may seem puzzling at first, but the apparent explanation is that the coverings of these Copepods do not repel water. A similar experiment to that already mentioned, where a little strip of blotting-paper was applied to the body of an animal lying in a minute quantity of water on a glass-slip, will prove that the water extends in a film quite over the body of such a form as *Cyclops* or *Diaptomus*. Why it is that with presumably the same covering-material the bodies of some Entomostraca should thus exhibit no power of water-repulsion, while the bodies of others, as already shown, are highly water-repellent, remains quite unknown.

In spite of the foregoing peculiarity of their coats, some Copepods are able to suspend themselves from the surface-film.

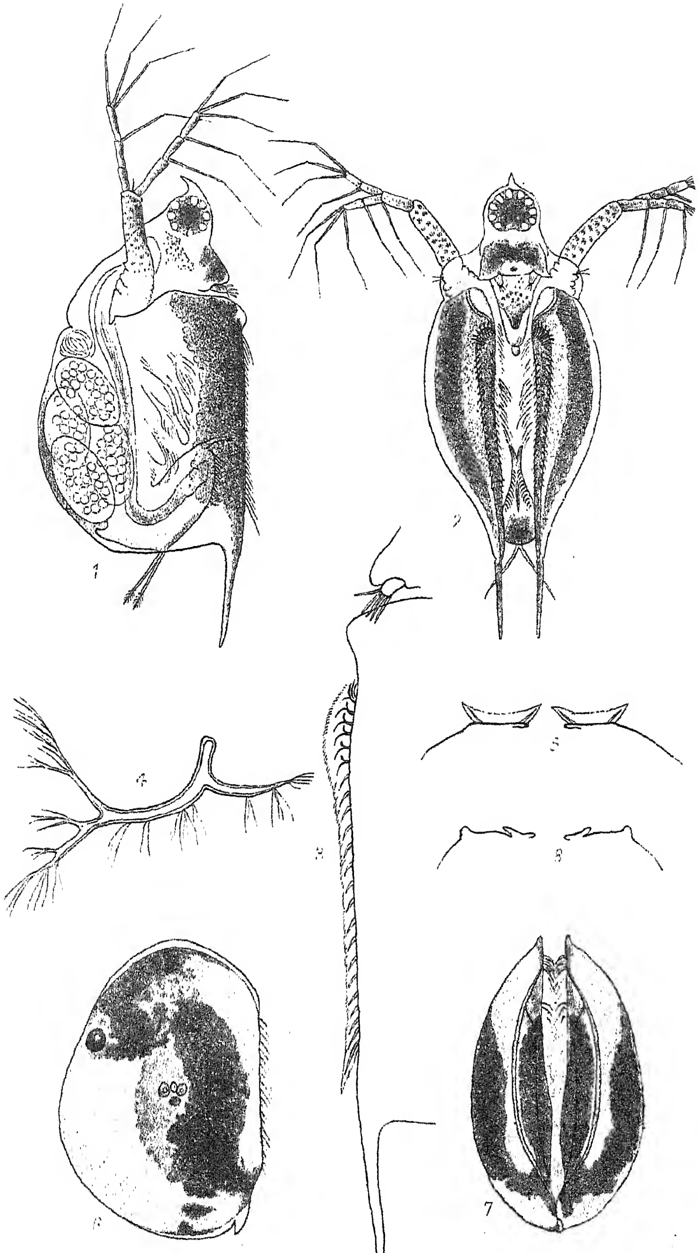
I have observed several species of *Cyclops* do this, but there are only two in which the habit appears to be in any degree a constant one, namely *C. signatus*, Koch (not including *C. tenuicornis*, Claus, although this form does sometimes suspend itself from the surface), and *C. prasinus*, Jurine (= *C. magnoctavus*, Cragin). When one of the former is closely watched, it will be seen that the animal suspends itself from the surface by means of the long setæ on the second pair of antennæ, exactly in the same way as it would do from a piece of weed. It should be especially noticed that the action is simply one of suspension, the animal always remaining quite motionless after taking up this position. Under the microscope there will be no difficulty in seeing that the two longest of the terminal setæ of each of the second antennæ have penetrated the surface-film, and are lying upon it for a small part of their length. If the reflected beam of light be used, as previously recommended, it will be found that four minute irregularities in the surface-film exist where the setæ break through.

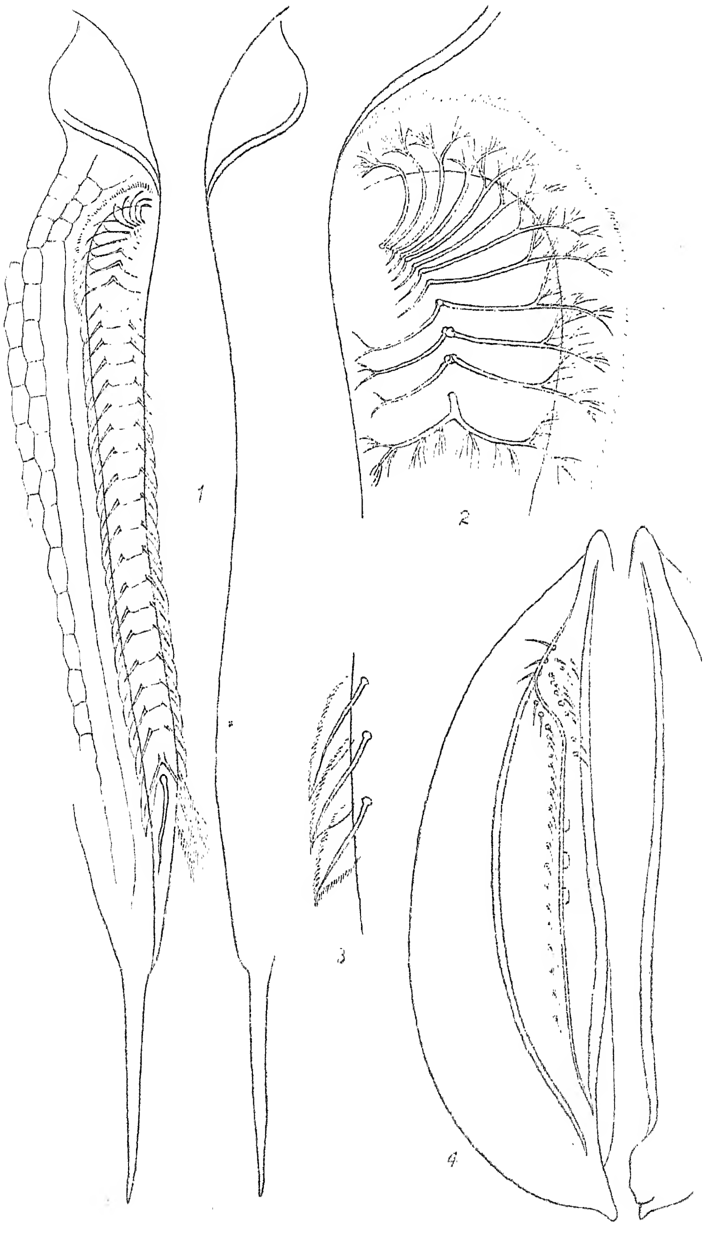
Since animals of this type are denser than water, though but slightly, these irregularities must be capillary depressions. It follows, therefore, that in all probability the explanation of the surface-using power of these species of *Cyclops* is exactly the same in principle as in the previous cases, notwithstanding that it has not been proved directly that the antennal setæ alluded to are water-repellent. One very curious point must not be omitted in regard to *C. signatus* and *C. prasinus*, as it is one which these forms have in common with *Scapholeberis* and *Notodromas*, but which at the same time distinguishes them from all other species of *Cyclops* known to me. It is that they are normally very dark-coloured, sometimes appearing almost black to the naked eye. The pigment producing this dark colour, while not by any means uniformly distributed over the bodies of these two species, is not so markedly ventral as is the case in either *Scapholeberis* or *Notodromas*. As, however, they do not bring any definite area of their bodies into contact with the surface-film, but simply hang from it obliquely, the view that here also the dark colour is protective may be provisionally accepted. Beyond the support afforded in water free from weeds, and the probable easiness of respiration, it is difficult to see what benefits these species of *Cyclops* derive from their power of clinging to the surface-film. They may, of course, also

be able to secure additional morsels of food floating on the surface, but so far this has not been observed.

There is yet another way in which the surface-film is utilised by some Copepods. In these instances the animals do not break the surface at all, but make use of the property which a small drop of water possesses of tenaciously adhering to even vertical and overhanging surfaces of solids, by reason of the tension of its enclosing surface-film. The process by which the animals referred to make use of this property is as follows:—When they attempt, as they often do, to force their way up the side, for instance, of a glass vessel, above the general level of the contained water, they become surrounded by a small quantity of water, which most persistently clings to them and to the glass, thereby binding them, so to speak, to the latter. By means of the support thus afforded, some Copepods can raise themselves up the sides of a glass vessel far above the water, and they no doubt raise themselves in a similar way up the exposed parts of the stems &c. of some water-plants. The forms that do this most constantly are certain species of *Canthocamptus*, e. g. *C. minutus*, O. F. M., and of *Cyclops*, e. g. *C. affinis*, G. O. Sars, and *C. phaleratus*, Koch. The last-named species affords perhaps the best example of all. I have repeatedly watched individuals wriggle their way up the sides of a bottle partly filled with water, until they have reached the underside of the cork, where they would stay for very long periods. It may be said quite confidently that, in captivity at least, this species spends more of its time above than below the water; yet its powers of locomotion in this way are not unlimited, for it is practically unable to force itself over dry surfaces. As to the advantages, disadvantages, and other problems connected with such a semi-aquatic mode of existence, nothing definite is known, and so here for the present the subject must be left.

Briefly summarised, the principal views advanced in this paper are as follows:—(1) To many Entomostraca the surface-film of water is a very dangerous element in their environment. To this category belong large numbers of the Cladocera and Ostracoda. (2) To some others, on the other hand, the surface-film affords peculiar advantages. This class includes, so far as is yet known, only a few specially modified Cladocera and Ostracoda, and some Copepoda, which do not, however, present any apparent


1
7


1
2
3
4

structural modifications. (3) In all cases (except where some Copepods possibly make use of the properties of the surface-film to attach themselves to aquatic plants above the general water-level) the relation to the surface-film, whether beneficial or the reverse, depends fundamentally upon the same physical principles, namely, the upward pull of the surface-film when forming a capillary depression, and the possession by the animals of water-repellent shells, ridges, scales, or setæ, capable of penetrating the surface-film and producing capillary depressions.

In conclusion I wish to express my best thanks to Prof. L. C. Miall, F.R.S., for his kind sympathy shown during the progress of this inquiry, and for many helpful suggestions.

EXPLANATION OF THE PLATES.

Plate I.

Fig. 1. *Scapholeberis mucronata*, ♀. Side view. × 55.
2. The same. Ventral view as seen when in contact with the surface-film. ×55.
3. The same. Ventral margin. ×110.
4. The same. Last of the anterior series of ventral setæ. × 1000.
5. The same. Diagrammatic section across the flattened ventral margins of the valves, showing setæ and hyaline scales.
6. *Notodromas monacha*, ♀. Side view. ×35.
7. The same. Ventral view as seen when in contact with the surface-film. ×35.
8. The same. Diagrammatic section across the flattened ventral margins of the valves showing ridges.

Plate II.

Fig. 1. *Scapholeberis mucronata*, ♀. Front view of ventral margin. ×200.
2. The same. Anterior series of setæ of ventral margin. ×700.
3. The same. Three setæ with hyaline scales from inner row of middle series. ×700.
4. *Notodromas monacha*, ♀. View of ventral flattened area. ×85.

On the Morphology of the Pedipalpi.

By Malcolm Laurie, B.Sc., F.L.S.

[Read 1st February, 1894.]

(Plates III.–V.)

I. Anatomy of *Thelyphonus*.

The internal anatomy of the *Pedipalpi* has, so far as my knowledge of the literature goes, never been described in any great detail *; and though the following notes do not pretend to touch on more than a few points, it seemed worth while to record them, if only by way of calling attention to the need for further investigation. That my material was limited in quantity and badly preserved, is the only excuse I can offer for the incompleteness of my observations, any attempts to trace the distribution of the nerves or the details of the reproductive system having been in vain. Sections through the whole animal were tried with some small specimens; but, apart from the difficulty of cutting an animal so abundantly provided with chitin, the inside was found to have lost all minute structure, and it was almost impossible to discriminate between the various organs.

Before entering on the subject of this paper, I wish to make a protest against the indiscriminate way in which Arthropod appendages are named. To take an example: an appendage is spoken of as "the third leg." Now this may mean (1) the third appendage; (2) the third postoral limb, *i. e.* appendage iv.; (3) the third walking-leg, which is in Scorpions appendage v., and in forms like *Phrynus*, in which appendage iii. is modified for tactile purposes, it may be either appendage v. or appendage vi. If one follows the same name through the Crustacea, the result is even more bewildering. The use also of terms such as antennæ, mandibles, &c. is objectionable, as implying homologies with other groups which are by no means certain; and it would be a great gain if writers would simply talk of the appendages by their number.

The hard parts of *Thelyphonus* are pretty well known, thanks to the works of systematic zoologists; but it will perhaps not be out of place to give a brief description of the chief points, especially as there are one or two new details to be noted. The sclerites of the dorsal surface may be dismissed in a few words as consisting

* The only figures with which I am acquainted are those of Blanchard in 'L'Organisation du Règne animal.'

of the carapace, behind which come nine band-like sclerites, the body ending in the three narrow, cylindrical sclerites of the tail. The second to eighth sclerites show depressions which indicate the points of attachment of the dorso-ventral muscles. On the ventral surface the carapace is bent over in front for a short distance. This infolded part is marked by a strong median longitudinal ridge which helps to separate the bases of the cheliceræ.

The *chelicerœ* (Pl. IV. fig. 13) are two-jointed, the distal joint being claw-shaped; it is strongly articulated to the first joint at the upper edge and folds down across its end, the point reaching to the lower edge. The proximal joint is roughly rectangular, as seen from the side, the length being about twice the breadth. In section the shape is an elongated oval, the long axis being dorso-ventral in direction. The surface of this joint is smooth except toward the distal end, where it is furnished, on the inner side, with a thick crop of hairs. The cheliceræ are not articulated to the rest of the skeleton, but attached by thin membrane to the thick membrane which forms the front of the cephalothorax in such a way as to be capable of being retracted for more than half their length (Pl. III. fig. 1).

The *second* pair of appendages are very powerful, and consist of six joints. In the middle line the first joints are fused together for about two thirds of their length, thus completely shutting in the mouth behind. Being thus fused, the first joint can no longer function as a jaw, as it does in the Scorpions, and the biting-function is consequently taken on by the second joint. Anterior to the point where the fusion ceases, the inner surface of the first joint has an organ corresponding to what has been termed the pseudotrachæa in Scorpions and *Phalangidœ* *, and which Gaubert † has shown to exist in *Phrynus*. This organ consists in *Thelyphonus* (Pl. IV. fig. 13, *p.s.t.*) of a trapezoidal area of thin skin closely covered with hairs. Except along the ventral margin the hairs are stout, with a well-marked central cavity, and covered with minute secondary hairs which give them a feathery appearance. Along the ventral margin is a ridge bearing stronger hairs, which, however, have not the feathery structure. At the anterior end is a small chitinous plate covered with short spines and bearing one or two long bristles which are

* Macleod, Bull. de l'Acad. Belg. vol. viii.

† Gaubert, Ann. Sci. Nat. sér. 7, vol. xiii. p. 140.

attached in the middle of circular thin areas, while just in front of this plate is a large bunch of simple bristles.

In the membranous area, bounded below and at the sides by the basal joints of the second pair of appendages, and at the top by the carapace, lies the opening of the *mouth* (fig. 13, *m.*). This is at the end of a short cylindrical tube, and is set round with hairs. The tube is strengthened below by a small chitinous plate with serrate anterior margin (fig. 13, *m.t.s.*), and above by the stronger and more important epistoma or camerostome. This epistome passes back through the membranous body-wall and projects into the interior of the thorax as three spines which reach as far back as the brain. These spines serve for the attachment of muscles connected with the stomodæum.

The rest of the ventral surface of the thorax is covered by two sternal pieces and the basal joints of the three walking-legs, which are fused to the body. The third appendage, which is long and slender and tactile in function, is attached close under the carapace to a membranous area lying between the second and fourth appendages. The posterior sternal piece is a truncated triangle in form, the posterior margin being bent up dorsally. Just beyond the end of this bent-up portion is a separate transverse piece of chitin, to which the dorso-ventral muscle from the second dorsal sclerite is attached.

The majority of the ventral *abdominal sclerites* want no special description, being almost precisely similar to the dorsal ones. This, however, is not the case with the first and second. The first sclerite, which we may term the *genital plate*, covers the ventral surface of the first two segments. The genital duct opens behind it, and under it at each side lies the first pair of lung-books. Round the posterior margin the chitin is bent in for a short distance in the middle line, but considerably more towards the sides. There are no dorso-ventral muscles inserted in this plate, those of the second tergite being, as mentioned above, inserted in front of it.

The second ventral sclerite (Pl. IV. fig. 14) corresponds to the third tergite; but owing to the great development of the genital plate it lies somewhat behind its proper position. The third ventral sclerite is narrower than the rest, for the same reason. The second sclerite resembles the first in covering a pair of lung-books which are situated at the sides, as well as in having the posterior margin bent in. This bent-in portion is very narrow

except at two points, one on each side of the middle line, where it runs forward into triangular processes. To the middle of the front edge of this sclerite is attached a chitinous plate, which runs forward forming the dorsal wall of the genital vestibule. The dorso-ventral muscles from the third tergite are attached on each side of this process.

There is little doubt that the genital plate corresponds to the genital plate of the Scorpion, and is an appendage; and I am inclined to consider the second sclerite as also an appendage. If, as I have tried to show in the Scorpion * and as Macleod † maintains in Spiders, the lung-books are derived from the adhesion of abdominal appendages to the ventral surface, there must have been an appendage here in the course of development, and at a comparatively late stage in the development of *Phrynus* ‡ this plate has quite a different appearance from the succeeding segments. The inturned posterior margin also and the absence of a dorso-ventral muscle inserted in the plate itself are suggestive, though I would not attach too much weight to the muscle as the points of insertion of such structures readily change. If this plate is to be regarded as an appendage, the anterior chitinous process to which the dorso-ventral muscle is attached naturally suggests itself as the corresponding sternite. This point also I would not lay much stress on until the development of this region is better known.

Internal Anatomy.

The greater part of the cavity of the abdomen is occupied by the enormous digestive gland—the so-called liver—which forms a solid mass concealing at first sight everything except the heart and a few muscles.

The *heart* (Pl. III. fig. 1) is about the same size from end to end of the abdomen, disappearing at the posterior end beneath a conical mass of muscle connected with the three caudal segments, and anteriorly passing into the thorax, about halfway up which it passes in among the folds of the stomach. Injection being impossible, no attempt was made to trace the further course of either end of the heart. A meshwork of small vessels, consisting of a pair of longitudinal vessels at each side with a transverse vessel in each somite, lies on the surface of the digestive gland, and is probably part of the blood-system.

* Zool. Anz. 1892. † Arch. Biol. vol. v. ‡ *Vide infra*, p. 34.

Underneath the heart lies the *gut*, which merits a somewhat full description. It commences at the mouth with a long stomodæum, which is lined by a thin chitinous cuticle. The anterior part of this stomodæum has muscles passing dorsally and laterally from it to be attached to three chitinous processes, which run back from the epistoma (camerostome) nearly as far as the brain. There is no appearance of a dilatation into a sucking-stomach such as is found in the Scorpion. A transverse section of the stomodæum (Pl. III. fig. 2 *a*) shows a folding-down of the dorsal side like the typhlosole of a worm. The sides of this down-folding are straight and covered with cuticle of the same thickness as that lining the walls of the stomodæum, while the free ventral edge of the fold is irregular in form and covered by much thinner cuticle. The only function I can suggest for this fold is that it acts in some way as a valve to assist in sucking.

Just behind the brain the stomodæum opens into the mesenteron (figs. 1 and 2). The first (thoracic) portion of this is expanded into wide lateral diverticula, which extend over the brain in front and the coxal gland at the sides. Each diverticulum is divided into five lobes, the cavity of most of which seems to be a simple space. The front diverticulum, however, and perhaps portions of the others, is cut up by a meshwork of tissue (*fig.* 1 *a*), the object of which is, I imagine, to afford a greater surface. The histology of this region I have not been able to study in any great detail; but it is evident that the thoracic diverticula are very different in structure from the abdominal diverticula or "liver." In addition to these lateral diverticula, there are two median ones from the ventral surface (fig. 2, *m.d.g.*). These pass through the entosternite, one going through the large oval anterior aperture in it and the other through the smaller posterior aperture (fig. 4). Ventral to the entosternite, these diverticula run forwards between it and the thoracic ganglion as simple tubes.

The middle portion of the mesenteron opens into the large diverticula of the digestive gland or "liver." There appear to be four pairs of these diverticula, the last one being very much the largest and opening from the gut about the fourth free segment. Behind the fourth segment the gut runs as a narrow tube as far as the seventh segment, and then expands into the large hourglass-shaped stercoral pocket (fig. 3). The peculiar shape of this stercoral pocket is due to its being compressed by the dorso-ventral muscles of the eighth free segment. The

posterior part is a great deal larger than the anterior, and fills the greater part of the ninth free segment. The epithelium lining the stercoral pocket (Pl. IV. fig. 15) consists of flat cells containing numerous granules, which stain darkly with hæmatoxylin along the outer edge. They are very similar to the cells lining the rest of the intestine. The *Malpighian tubes* arise near the posterior end of the stercoral pocket and run forward along the sides of its ventral surface. They are somewhat coiled and closely attached to the pocket by connective tissue. In section they are found to possess an indistinct lumen surrounded by large cells with distinct oval granular nuclei. Occasionally darkly staining granules appear in the protoplasm, but for the most part it is apparently structureless (Pl. IV. fig. 16). The coils of the Malpighian tubes are surrounded and held together by fibrous-looking connective tissue.

The *proctodæum* is a short straight tube running back through segments 10–12 to open below the telson. A slight thickening marks its junction with the mesenteron close behind the stercoral pocket. The epithelium lining it is thrown into folds, and consists of long cells with apparently a cuticle over their outer surface (Pl. IV. fig. 17). The distinction between these cells and those lining the stercoral pocket is quite evident, and the transition from one form to the other somewhat abrupt.

In describing the stercoral pocket as part of the mesenteron, I have been influenced by the character of the epithelium lining it and passing forward into the intestine without any break, while differing so markedly from that lining the proctodæum, and also by the point of origin of the Malpighian tubes. The condition of things in the embryos of *Phrynus*, which are described below, admits of little doubt as to the origin of the stercoral pocket from the mesenteron.

The *entosternite*, which is so characteristic of Arachnids, deserves a few words of description in this form (Pl. III. fig. 4). It lies between the gut and the thoracic ganglion, and is best described as an elongated plate drawn out into a number of processes. The front margin of it lies immediately behind the cerebral ganglion, and a pair of processes run forward one on each side. A large oval foramen perforates the plate near its front end, through which the anterior median diverticulum of the gut passes. Near the level of the posterior end of this foramen a second pair of processes passes onward and dorsalward. A little

behind the large oval foramen lies a small subcircular one, through which the posterior median diverticulum of the gut passes, and a third pair of processes is given off at about the level of the front of this circular foramen. Behind this second foramen the entosternite is a solid plate. At first it narrows somewhat, but soon expands again and runs out into the fourth and last pair of processes. This entosternite is more complicated than is usual in Arachnids, and this is probably to be correlated with the greater development of the thorax and its appendages. The processes into which it is drawn out serve for the attachment of muscles. The first pair of processes has muscles from it to the large second pair of appendages, while the other three serve for the muscles of the three walking-legs, the thin third pair of appendages being without any special process.

The *nervous system* is almost entirely concentrated in the thorax. The cerebral ganglia are small oval structures placed far back in the thorax (Pl. III. fig. 4) and giving rise to two pairs of optic nerves. The far back position of these structures is due to the large cheliceræ which, when drawn in, occupy almost the whole of the region in front of the brain. The three processes from the epistoma, of which mention has been made, also reach as far as the brain. The thoracic ganglion (fig. 5) is subtriangular in form, and gives rise to the nerves for the greater part of the body. The origin of the nerves to the first two appendages could not be clearly made out, as the front part of the ganglion is somewhat entangled in chitinous processes which come in from the floor of the thorax. The nerves to appendages iii. to vi., however, are quite distinct, and the posterior end of the ganglion finally gives off a paired nerve-cord, alongside of which run a number of fine nerves, the course and distribution of which I failed to trace. The nerve-cord runs straight back without any ganglia till it reaches the ninth free segment, in which there is a small oval ganglion lying on the top of the right stink-sac (fig. 6). A nerve passes out laterally from each side of this ganglion, and a pair pass also posteriorly into the tail.

The *reproductive organs* have been recently described *, but as the paper only gives two schematic figures it is not of much assistance in dissecting out these parts. Both the specimens which I dissected were males, and their reproductive organs were disposed as follows:—The testes are a pair of straight

* Biol. Centralbl. ix.

tubes which lie side by side near the middle line, reaching as far back as the eighth free segment. In the third and fourth free segments they become narrowed into short vasa deferentia, which open into the enormous seminal vesicles situated one on each side of the first segment (fig. 8). These seminal vesicles open in the middle into what may be termed the genital vestibule, which runs straight back to open to the exterior at the posterior edge of the genital plate. The dorsal wall of the posterior part of this genital vestibule is formed by the median anterior process of the third segment. Each of the seminal vesicles contains two hard brown structures in the form of curved grooved rods. One pair of these rods is united in a plate-like expansion in the middle line. The other pair seem to be independent of each other. No muscles could be found in connection with these structures, and their function—except in so far as they serve to keep the seminal vesicles dilated—is not evident. The walls of the genital vestibule are strengthened by two curved chitinous bars (fig. 8, *cl*), which seem independent of the genital plate, though coming into close contact with its inturned margin at their posterior ends. A small ring of chitin (Pl. III. fig. 8, c^2) also lies in the dorsal wall of the vestibule in front of the median anterior process of the third segment.

Underneath the testes, underneath even the nerve-cord, lies, in the middle line, the right sac of the *stink-gland* (fig. 6). It is in contact on the ventral side with the body-wall and reaches forward as far as the fourth segment, and the width is about half that of the space between the dorso-ventral muscles. Traced backwards, it narrows considerably in the tail-segments, and passing to the right of the rectum opens close to the middle line between the anus and the base of the telson. The walls of this sac are thin and translucent, and are thickened by a number of longitudinal white strands, which are due to the internal wall of the sac being folded into complex longitudinal ridges (fig. 6 *a*). These ridges suggest that the walls of the sac secrete the odorous fluid; but the free surface is covered by a well-marked cuticle which is very impervious to staining fluids, and one would suppose equally so to secretions. The left sac of the stink-gland lies outside the left dorso-ventral muscles, and the narrow posterior end passes to the left of the rectum to open close to the aperture of the right one. It does not reach so far forward as the right one, but ends in the middle of the fifth segment. The

structure and appearance are precisely similar to what has already been described. This asymmetrical arrangement of what one must regard as a morphologically symmetrical structure is interesting on account of its rarity. The Arthropoda are essentially bilaterally symmetrical animals, and yet here we have a bulky organ disposed in a completely unsymmetrical way, and that without appreciably affecting any of the other organs in the same region of the body. The extreme ventral position of these sacs is also worth noticing, as it is but seldom that any structure of importance comes to lie between the nerve-cord and the ventral surface.

Twisting about on both sides of the central or right stink-sac, but more especially on the right side, where there is more room, is a convoluted mass of fine tubules. The convolutions are so complicated and the tubules so fragile, that I have not been able to ascertain how many tubules are present or whether they branch or anastomose. This last is probably not the case, as I could scarcely have failed to get some trace of branching if it were present. I have traced two of these tubules apparently opening into the distal, *i.e.* anterior, end of the left stink-sac, and have little doubt that others open similarly into the right one. I take these tubules to be the purely secretive part of the stink-gland, and imagine that they discharge their secretion into the sacs, from which it is ejected in considerable quantities when necessary.

The *coxal gland* (Pl. III. figs. 2 and 4, *cox.*) lies in the thorax on either side of the entosternite, the processes of which pass dorsal to it. It is an elongated body with a wavy outline, and the convolutions of the tube of which it is composed may be seen on the surface. At the front end it gives off a duct which runs alongside the foremost process of the entosternite, and then curving outwards passes into the base of the third appendage. I have been quite unable to find any aperture on the external surface in this region, but there is a considerable membranous area in which such an aperture might easily be overlooked. At the same time it is quite possible that the duct may be closed in the adult, or only open at special seasons as in *Mygale*.

The *lung-books* are situated, as has been already stated, towards the sides, beneath the first and second abdominal sclerites. The lamellæ lie for the most part horizontally, though curving up a little towards the outside. Each lamella has a comparatively short posterior edge where it abuts on the air-space (fig. 8).

The two sides run forward, diverging from each other, the outer side being the longer, and the anterior edge runs obliquely forward and outward. A thin chitinous cuticle covers both sides of each lamella, between the two layers of which is the blood-space. Occasional cellular columns pass across the blood-space from one cuticle to the other. The cuticle on the dorsal side of each lamella is covered towards the free margin (Pl. IV. fig. 9) by a number of vertical chitinous rods, the summits of which are united to form an arcade structure. Further away from the free margin these rods become smaller (fig. 10), and seem to be firmly attached to the ventral surface of the overlying lamella. Whether the ordinary small rods are actually continuous with the chitin of the overlying lamella, I cannot be sure, but certain thicker rods which occur here and there certainly are continuous. There is in this region no appearance of an arcade structure. The free edge of each lamella is enormously thickened (fig. 9), the thickened rim tending to run into sharp points on the dorsal surface and along the edge, while it is smoother and more solid on the ventral surface. The arcade structure gradually dies out towards the edge, though it persists for some distance along the thickened portion.

The posterior side of the air-chamber is bounded by a membranous wall, which is strengthened by a network of curved chitinous bars (Pl. IV. fig. 11). These bars are every here and there drawn up into blunt processes, and small knobs of chitin make their appearance on the membrane within the meshes. At the sides of the air-chamber where the ends of the free edges of the lamellæ are attached to it, the wall is enormously thickened (fig. 12) and drawn out into irregular conical processes. The surface of this part of the wall is further closely covered with stiff hairs.

The structure of these lamellæ differs from that described by Berteaux * for Spiders chiefly in the greatly thickened free margin. In other respects the similarity is very close.

Caudal Organ.—On the dorsal surface of the last segment lies a pair of oval white spots, which have been called the apertures of the stink-glands (fig. 1, *c.o.*). Sections through this portion of the integument, however, show that there is no aperture at this point. The chitinous cuticle is much thinner than elsewhere (Pl. III. fig. 7), and the underlying layer of cells shows an entirely

* La Cellule, vol. v.

different form. Over the rest of the body the hypodermis consists of somewhat flattened cells with circular nuclei, but in the region of this caudal organ the cells are columnar with large oval nuclei. In one dissection I thought I could trace a nerve to these cells, but I could not be certain. The appearance of these columnar cells suggests a sense-organ rather than a gland, and indeed we have found the stink-gland to be an entirely different structure. What sense this organ serves is, however, not so clear. It is almost certainly not an organ of sight, as there is no pigment in or around the cells and the overlying cuticle shows no modification for any optical purpose. It is probably then either auditory, olfactory, or for the sense of temperature, as are the lyriform organs of Spiders according to Gaubert *, but which must be left undecided until the minute structure can be investigated on properly preserved material and experiments made on the live animal.

II. Some Embryos of *Phrynus*.

While examining the Pedipalpi in the British Museum collection, Mr. Pocock directed my attention to a few specimens of *Phrynus* which had embryos attached to them. Inasmuch as practically nothing is known of the development of these forms †, it seemed well worth while to examine what embryos there were, though the number of specimens and state of preservation were evidently not such as to make anything approaching a satisfactory account possible. Through the kindness of Dr. Günther I have been able to cut sections through four stages, and have made out a few points which are, I think, not devoid of interest. Unfortunately, two of the four stages were too badly preserved to show anything, so my results are based on two somewhat late stages.

The development of *Phrynus* takes place, not, as usually stated, within the mother, but the embryos are carried in a sac formed of dark brown transparent gelatinous-looking material attached to the ventral surface of the mother (Pl. V. fig. 18). The abdomen is concave on the ventral surface where this sac is present, and the dorso-ventral measurement is so much reduced that it seems a question how the organs necessary for existence can be contained

* Ann. Sci. Nat. sér. 7, vol. xiii.

† Bruce, Johns Hopkins University Circulars, vol. vi. 1886, describes only a few points, and that without figures.

in it. By what means the sac is formed and attached, I have not been able to find out. It coincides in shape with the abdomen, of which it covers all except the first two segments. The anterior part of it and the sides are thin, but the greater part of the ventral surface is covered by a roughly quadrilateral thicker portion, the margin of which is thicker than the rest. At the posterior end—at least in *Phrynus reniformis*, in a specimen of which the sac was best preserved—this thickened portion runs out into two short acute triangular processes. This method of carrying the young agrees with what is known of the habits of *Thelyphonus*.

As mentioned above, the only embryos of which I have been able to cut sections are in a comparatively advanced stage of development. One specimen of *Phrynus reniformis*, however, in the British Museum was apparently at an early stage (Pl. V. fig. 19). In surface view it consisted, as nearly as one could ascertain, of a large cephalic lobe followed by seven or more paired white blocks, extending round about half of the spherical egg. It was evident that only the thicker parts of the embryo were visible, and I take it that the paired blocks are the mesoblastic somites of the embryo, while the cephalic lobe is due to the thickening to form the brain. In the absence of sections, however, any attempt to determine these characters can scarcely be trustworthy.

The older embryos have already the limbs well developed, and the body has undergone reversion similar to what occurs in Spiders (Pl. V. figs. 20 and 21). Just above and a little in front of the base of the fourth pair of limbs is seen a sac-like expansion, the surface of which, as also that of the body and legs in the immediate neighbourhood, is covered with a dark layer, apparently formed by the coagulation of some liquid excretion. In section the sac is seen to be hollow, but it was not possible to trace the cavity into connection with that of any other organ. The cuticle covering the sac is peculiar in that it is covered with blunt, conical, hollow processes which I believe are perforated. The cells forming the wall of the sac having drawn away from it owing to preservation, it was impossible to say whether processes from them extend into the cuticular processes or not, but I am inclined to think that such processes existed.

The presence of this sac was noticed by Bruce *, and a similar

* Bruce, A. J., "Observations on the Nervous System of Insects," &c. Johns Hopkins University Circulars, vol. vi.

organ has been described in *Galeodes* by Croneberg *. Bruce considers it to be a sense-organ, while Croneberg compares it with the paired processes in *Asellus*, which probably represent the remains of the shell.

Bruce has described a cellular amnion round his embryos. Of this I can find no distinct trace, but it may have atrophied at an earlier stage.

The embryo appears, however, to cast off at least one cuticle in the course of development. This cuticle follows roughly the outlines of the body, and seems to be cast off during the later stages of the process of reversion, as there are cross partitions between the layer covering the cephalothorax and that over the abdomen. Between these two layers, and therefore outside this cuticle, there are traces in one of my embryos of a thin-walled sac with granular contents, but whether this is the remains of a still earlier cuticle or not I am unable to say.

The Gut (Pl. V. fig. 21).

The gut is composed, as usual, of three well-marked divisions—Stomodæum, Mesenteron, and Proctodæum. The stomodæum is a narrow tube extending from the mouth to a little behind the brain. In front of the brain there are attached to it powerful muscles running dorsally to be inserted in the carapace behind the median eyes. Lateral muscles are also present in this region, which no doubt has a suctorial function, though there is no sign of any dilatation to form a sucking stomach. Close behind the brain and just in front of the junction between the stomodæum and the mesenteron are inserted some more muscles which also pass dorsally to the carapace.

The anterior part of the mesenteron—*i. e.* the part lying in the cephalothorax—is dilated to form a sort of stomach as in *Thelyphonus*. The dilatation seems to take the form of a single pair of lateral outgrowths, very similar at this stage to the lobes of the "liver." A small median ventral outgrowth is also present, and reminds one of the median processes in *Thelyphonus*. The middle part of the mesenteron is very short, only extending as far back as the fourth free segment. There are four pairs of diverticula forming the so-called liver, of which the first three divide almost immediately into a dorsal and ventral portion. The "liver" lobes of these three are small and well defined, the

* Croneberg, Zool. Anz. 10 Jahrg. 1887.

ventral part of the first two being much smaller than the dorsal. They are placed in front of the first dorso-ventral muscle (*i. e.* the muscle of the second segment), and between the first and second, and the second and third dorso-ventral muscles respectively. The fourth diverticulum is very much larger than the others, and runs back along each side of the gut, somewhat dorsal to it. It opens into four secondary lobes on the ventral side, lying in the 4th, 5th, 6th, and 7th segments respectively, and is continued, though much reduced in size, as far as the posterior end of the body.

Behind this middle section of the mesenteron comes a considerable length of narrow intestine, which expands about the seventh segment into a great oval stercoral pocket which reaches to the posterior end of the body. This stercoral pouch is in absolute continuity with the rest of the gut, and is, I have no doubt, derived from the hypoblast.

The proctodæum consists of a solid mass of cells, which comes into contact with the closed posterior end of the stercoral pocket. The cells are, however, quite different in appearance from those lining the stercoral pocket, and though in contact, the line of demarcation is perfectly distinct.

The Nervous System.

I have been able to make out but little as regards the development of the nervous system, as in my younger stage it is practically fully formed, though, as is usually the case with embryos, far larger in proportion than in the adult. The ganglion for the cheliceræ is quite distinct from the brain in my embryos. Ganglion, by the way, used in this sense has exactly the opposite meaning to that in Vertebrata. In the latter it means a collection of nerve-cells, while in the Arthropod cephalothoracic nervous system it means a mass of white substance among the nerve-cells. Behind the ganglion for the cheliceræ are five, somewhat larger similar ganglia appertaining to the five other appendages. Then come six very small separate masses of white substance, and finally a single elongated mass from which the nerve-cord runs out. I have not found in these stages any distinct division of the cerebral ganglion into three, such as has been described for *Limulus* * and Spiders. The distinction between the cells forming the dorsal mass of the cerebral ganglion and those lying

* Patten, Q. J. M. S. vol. xxxv.

on its sides is well marked here, as in Scorpions, the former being smaller and more closely packed.

The central eyes are formed, as in Scorpions * and Spiders †, by an in-pushing from in front of where the eye is about to be formed, the dorsal wall of which in-pushing forms the retinal cells, while the ventral wall forms a layer of flattened cells bounding the retina on its ventral side. The nervous system being already separated from the skin in my younger embryo, I cannot say whether or not part of the cerebral ganglion is formed from the optic in-pushing as in Scorpions. As in other Arachnids, the central eyes are diplostichous and the lateral eyes monostichous, the latter being formed by a modification of the hypodermis-cells *in situ*.

Coxal Gland.

The earlier stages of this structure are not represented in my specimens. In the younger it is already a considerably coiled tube. The tube is lined by cubical epithelium, the cells of which have round lightly-granular nuclei. Towards the front end a duct passes from the coiled tube and opens to the exterior on the posterior face of the basal joint of the third appendage (Pl. V. fig. 23). The epithelium lining the duct differs from that of the coiled tube, the nuclei being more closely packed, somewhat larger, oval, and more darkly staining. They resemble pretty closely the nuclei of the hypodermis, and as the duct has a thin cuticular lining, it probably represents the ectodermal part of the coxal gland. No trace of an enlarged terminal sac, such as that described by Faussek ‡ in *Phalangium*, could be found, but it may be present in younger stages.

The Respiratory Organs.

The lung-books in the Pedipalpi are two in number, the first lying under the large genital plate, and the second under the next sclerite, which corresponds to the third free segment. An early stage of development is shown in Pl. V. fig. 22, which is a longitudinal section to one side of the middle line. i. is the genital plate, and iii. the sclerite immediately behind it. The two resemble one another so closely that a description of one of them will serve for both. iii., then, consists of a distinct outgrowth

* Laurie, Q. J. M. S. vol. xxxi., and Parker, Bull. Mus. Comp. Zool. Harvard, vol. xiii.

† Locy, Bull. Mus. Comp. Zool. Harvard, vol. xii.

‡ Faussek, Travaux de la Soc. d. Nat. St. Pétersb. vol. xxii. (Russian); Abstract in Biol. Centralbl. 1892.

from the body-wall, the cavity of which contains at this stage a certain number of mesoderm-cells. The hypodermis over the greater part of it is very much like that of the rest of the body. On the posterior surface, *i.e.* the surface next to the body-wall, however, the inner two-thirds is thickened, and the cells of the thickened portion are beginning to arrange themselves in rows more or less at right angles to the surface of the outgrowth. This is the beginning of the lung-book. That this lung-book belongs to the segment to which it is at this stage attached and not to the one behind it is, I think, fairly certain. With regard to the first lung-book, which appears to be attached to the posterior surface of the genital plate, it is not so evident to which segment it belongs. The genital plate covers the ventral surface of the first two segments, and the lung-book may either be attached to the genital plate, and therefore belong morphologically to the first segment, of which the genital plate is the appendage, or it may be the sole survival of the appendage of the second segment, which has otherwise entirely disappearad. This last I have suggested as being the case in the Eurypteridæ *; and I believe it to be the correct explanation in these forms also, but only an examination of earlier stages can prove it. At all events, it is pretty certain that the first lung-book belongs to segments i. or ii., and not to segment iii. It is therefore not homologous with the first lung-book of the Scorpion, which does belong to segment iii., but is either the homologue of the pectines of the Scorpion, *i.e.* appendage ii., or is a special structure, the appendage of segment ii. having entirely vanished. The former is evidently more probable *a priori* †.

Of the development of the other organs I have not been able to make out anything of importance. The whole of this paper is, I feel, calculated rather to show what we may expect when the embryology of this group is properly worked out than to say what actually happens. If I have shown what important results a study of these forms will almost certainly give us, and how heavily handicapped any attempt to deal with the morphology of the Arachnida must be until such a study has been made, I have done all that I expected with the material at my disposal.

* Trans. R. S. Edinb. vol. xxxvii.

† A paper on the "Development of the Lungs in Spiders," by O. L. Simmons in the Am. Journ. Sci. Nat. for August 1894, shows very similar structures, and the author's conclusions agree for the most part with mine.

General Considerations.

In the following pages I only propose to consider a few points in Arachnid morphology on which it seems to me that my observations have thrown some light. Many points—such as the existence of a number of pre-oral segments in the embryo—I have not dealt with, because it seems better to wait for further observations rather than to try and generalize on a manifestly insufficient basis.

Post-oral Thoracic Appendages.

Gaubert *, in his recent paper on the Arachnids, treats of the limbs of the terrestrial forms at some length, but his conclusions do not appear satisfactory to me. He considers the typical walking-leg of the Arachnids to consist of six segments, the articulations between which are capable of dorso-ventral motion. Antero-posterior motion has been acquired in most forms, but always by the formation of a secondary joint, which has arisen in various parts of the leg in different forms. Thus, in Pedipalpi, Phalangidæ, and Spiders the fourth segment has been divided; in Scorpions the fifth, and in *Galeodes* the third. That secondary jointing does take place in some forms is certain, but that all the articulations capable of antero-posterior motion are due to it I doubt. In the figure on p. 37 I have drawn a number of legs of different forms, a glance at which will make my views clearer than pages of description. The numbers *above* each figure are those of the segments of the limb as I interpret them, those in brackets below are according to Gaubert. The articulation capable of antero-posterior movement is marked with an asterisk. In a primitive limb, then, for a type of which I will take that of one of the Eurypterids, we have seven segments, of which the first is modified for mastication, and the articulations of which are capable of movement in any direction. Appendage ii. seems, in contradistinction to the rest, to have only six segments in all forms. The following are the chief modifications which have taken place in the various orders:—

(a) *Eurypterids.*—Appendage ii. may have a tactile function, as in *Slimonia.* Appendage vi. is always larger than the rest and usually flattened to form the swimming-foot. In *Stylomerus*, v. and vi. are enormously elongated. An epicoxite is present in some of the limbs.

* Ann. Sci. Nat. sér. 7, vol. xiii.

(b) *Limulus*.—The masticatory function is retained throughout. Appendage ii. has six segments and is chelate. Appendages iii.–vi. are always described as having six segments, but there is distinct evidence of a fusion of segments 4 and 5. Appendages iii.–v. are chelate, while vi. bears a number of spines at the articulation between 6 and 7, and also at the end of 7. There is,

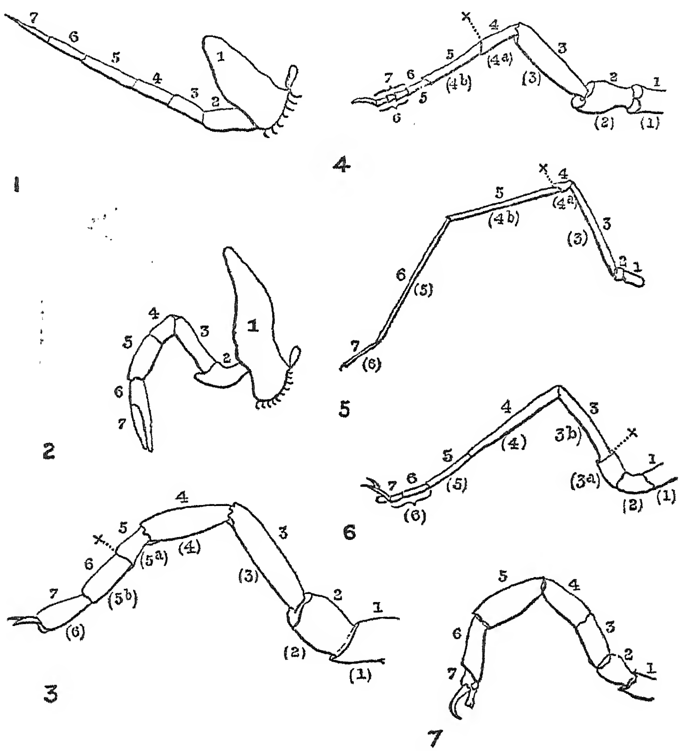


Fig. 1. *Pterygotus*. Fig. 2. *Limulus*. Fig. 3. Scorpion. Fig. 4. *Thelyphonus*. Fig. 5. Spider. Fig. 6. *Galeodes*. Fig. 7. *Pseudoscorpion*.

further, a curious outgrowth from the external side of segment i., which seems to be of importance, as it is well developed at a comparatively early stage*, but the morphological significance

* Kingsley, Journ. Morph. vii.

of which is unknown. An epicoxite is present in appendages iii.–v.

(c) *Scorpions.*—The masticatory function has been lost, except in appendage ii., though the expanded first joint persists in iii. and iv., and serves to shut in the mouth behind. An epicoxite is present in iii. * The third segment has an ascending position, the fourth is almost horizontal. The articulation between 5 and 6 is modified for antero-posterior motion.

Pedipalpi.—The masticatory function is retained in appendage ii. in *Phrynus*, but not in *Thelyphonus*, in which the first joints of this limb are fused and perform the function of appendages iii. and iv. of the Scorpion. Appendage iii. is modified as a tactile organ, the last four joints in *Phrynus* and the last three in *Thelyphonus* being secondarily segmented. The first segment of appendages iv.–vi. is fused to the body—more completely in *Thelyphonus* than in *Phrynus*. Segment 3 is ascending in direction in these limbs, and the rest descending. Articulation 4–5 is modified for antero-posterior motion, and segment 7 forms a three-jointed tarsus. Appendage vi. in the Phrynidæ undergoes secondary segmentation of segment 5 in many forms. *Phrynichus* (*ceylonicus*) has the segment normal; *Damon* (*medius*) has it divided into two; *Tarantula pumilis* (C. L. Koch) has three segments in this region, and *Phrynus Grayi* (?) four †.

Araneidæ.—These are similar in arrangement to the Pedipalpi, except that segment 7 is not divided up into a tarsus. Appendage ii. is tactile, not prehensile, and undergoes curious modifications in the male.

Phalangidæ.—The masticatory function is retained by appendages ii. and iii., while appendage iv. has still a process projecting towards the middle line. The rest of the limbs are similar to those of Spiders, except that segment 7 is divided into a many-jointed tarsus.

Galeodes.—The masticatory function is entirely lost. Appendage iii. is slightly modified for tactile purposes, having practically lost the claw and apparently segment 7. This loss of a segment is curiously in contrast with the multiplication of segments in the corresponding limb of the Pedipalpi. In appendages iii. and iv. an additional joint is intercalated between segments 2 and 3. This may be due to division of segment 2,

* Lankester, Q. J. M. S. xxi.

† Karsch, "Zur Kenntniss der Tarantuliden," Arch. f. Naturg. vol. i.

but more likely, as Gaubert suggests, to division of segment 3. Antero-posterior motion takes place between this additional segment and 3. In appendages v. and vi. a second segment is intercalated in this region. Whether the intercalated segment is connected with a horseshoe-shaped strip of chitin which strengthens articulation 2–3 in the Pedipalpi or not, is an interesting point which must remain for the present unsolved.

Pseudoscorpions.—In these minute forms the masticatory function has been lost, except in appendage ii. In the other limbs segments 3 and 4 are fused together, their line of junction being marked by a groove, while segment 7 is so reduced as to have been overlooked by everyone except Croneberg. The limbs are exceptional in that the division between the ascending and descending portions of the limb occurs at articulation 4–5 instead of articulation 3–4.

Acarina.—The limbs here seem to have only six segments, but my researches have not led me to any conclusion as to which segment is lost. Appendages i. and ii. are variously modified in connection with the modes of life of the different forms. As being a degenerate group derived probably from the neighbourhood of the Phalangidæ (Bernard says from the Araneidæ) they need not detain us here.

To summarize the results obtained from the above brief account of the appendages, the terrestrial forms seem to differ from the aquatic ones (*Limulus* and *Eurypteridæ*) in that the majority of the appendages have lost their masticatory function. This confinement of mastication to a smaller area seems to me a natural result of terrestrial life in such forms as these, which suck in their food in a liquid form, since a contingency to be by all means avoided is evidently that the juices on which they subsist should dry up. Beyond this the modifications of the appendages would seem to unite the Pedipalpi, Phalangidæ, and Araneidæ together as a natural group. The Scorpions differ from them on one side, and *Galeodes*, as usual, stands alone on the other, though apparently showing affinities to the Pedipalpi. The condition of things in the Pseudoscorpions points either to their type of limb being independently derived from a comparatively primitive form, or to their having passed through a much simplified stage, like the Acarina. I think the latter more probable, though I wish it to be distinctly understood that I do not propose to derive the Pseudoscorpions from the Acarina.

Abdominal Appendages and Respiratory Organs.

The full number of abdominal appendages (six) only persist as such in *Limulus*. In this form they are somewhat modified, the plates of each pair being connected in the middle line. That this connection is secondary is evident from Kingsley's * figures, which show the abdominal appendages quite distinct from each other in early stages. The other aquatic forms, the Eurypterids, differ from *Limulus* in the segmentation of the abdomen. The first appendage is fused in the middle, and bears a well-developed median lobe, which probably has some function in connection with reproduction, and is in some forms at any rate capable of partial invagination. The second abdominal segment is covered by this genital operculum and has no plate-like appendage, though it bears a number of branchial lamellæ. The third to sixth segments bear paired plates with branchial lamellæ on their posterior surfaces. The sternites persist in these segments; at all events in *Slimonia*—and this, one would expect, as a segmented abdomen demands greater strength than one in which the segments are fused together as they are in *Limulus*.

I have stated elsewhere † what I believe to be the case as regards the morphology of the anterior abdominal segments in *Scorpio* and the Pedipalpi. To recapitulate briefly, the Scorpions have all the segments well-developed, the second segment bearing the pectines, and the third to sixth having lung-books. The genital plate is small and does not overlap the second segment. In the Pedipalpi the genital plate covers two segments as in Eurypterids, the second of which bears the first pair of lung-books, which consequently lie under the genital plate. The third segment is also covered by an appendage under which lie the second pair of lung-books. I think the anatomy and still more the development, as described above, fully bear out this view. There can be no doubt that the first pair of lung-books in the embryo *Phrynus* belong to the region covered by the genital plate and not to the third segment. The first pair of lung-books in the Pedipalpi thus correspond to the pectines of Scorpions. Another difference between the lung-books of these forms seems to be that in *Scorpio* they are formed, as I have elsewhere maintained ‡, from paired appendages not united in

* Journ. Morph. vii.

† Trans. R. S. Edinb. vol. xxxvii.

‡ Zool. Anz. 1892, no. 386.

the middle line, but in the Pedipalpi the appendages stretch right across, as Macleod * suggested for spiders.

This view differs from that which has recently been set forth by Pocock †, who regards all the sclerites as sternites, and considers that the ventral side of the second abdominal segment has been crushed out by the great development of the first, which extends so far back as to cover part of the third segment, including the first pair of lung-books. The second sternite, that of the third segment, has, according to him, been pushed back by the same growth so as to cover the second pair of lung-books, which belong to the fourth segment.

Schizonotus, which I have unfortunately not had an opportunity of studying, is thus described by Pocock :—" There appears usually to be a single pair of respiratory stigmata situated behind the first sternite, as in *Thelyphonus*. The posterior pair that are developed in *Thelyphonus* appear to be functionless, but upon the third, fourth, and fifth sterna (morphologically the fourth, fifth, and sixth), close to the posterior margin and behind the muscular impressions, a pair of dusky patches are visible. These appear to be some internal organs seen through the semi-transparent cuticle, and I believe they are the homologues of the three posterior pairs of lung-sacs of the Scorpion "‡. If this interpretation of these structures be correct, we have here traces of the posterior abdominal appendages which have entirely disappeared in *Thelyphonus* and *Phrynus*.

In *Spiders* the same arrangement is found as in the Pedipalpi. This is particularly clear in that curiously primitive form *Liphistius*, which has been recently described by Pocock §. In this form the segmentation of the abdomen is marked on the dorsal side by nine (Schiödte) chitinous tergites. On the ventral side there are two large chitinous plates, the anterior of which covers the genital aperture and the first pair of lung-books, while the posterior covers the second pair of lung-books. These two chitinous plates I would regard as the two appendages which are found in the Pedipalpi. A further argument in favour of my view is that the lung-books have been described as developing in connection with the appendages of the second abdominal segment.

* Arch. de Biol. vol. v.

† Ann. & Mag. Nat. Hist. vol. xi. 1893.

‡ *Tom. cit.* p. 4.

§ *Op. cit.* vol. x. 1892.

In the Dipneumones the posterior pair of lung-books are replaced by tracheæ which, according to this view, have developed by an extension of the air-chamber of the lung-sac, as has been suggested by Macleod *.

Two pairs of abdominal appendages seem to be converted into spinning mammillæ in the Araneina. In *Liphistius* they occupy a normal position on the ventral surface of the abdomen, but in the higher forms, in which the segmentation of the abdomen has been entirely lost, they are shifted to a posterior position. This accounts for five appendages of the abdomen, which is all that seem to appear in the embryo. It may be advanced as an argument against my view, that if we consider the second lung-book as belonging to the fourth abdominal segment instead of the third, then we have, with the spinning mammillæ, all six abdominal appendages accounted for; but it seems to me more likely, without considering other reasons, that the sixth appendage has vanished than that the second has disappeared without leaving any trace.

In the other Arachnids the lung-books are replaced by tracheæ. Of *Galeodes*, the *pons asinorum* of all who have tried to deal with Arachnid morphology, I do not intend to speak here. The presence of stigmata leading into tracheæ between the fourth and fifth thoracic appendages is perplexing, not to say bewildering. I fully agree with Bernard in considering this form of great importance, though I do not feel convinced of its being primitive in most respects. We must wait, however, till we have a more careful and detailed account of its anatomy than has yet been published before we can speculate as to its morphology with any hope of success.

It has often been maintained that the lung-books of Arachnida are derived from tracheæ and not from branchiæ; but this view cannot, I think, be accepted. The fact that lung-books are characteristic of the two most primitive orders—the Scorpions and the Pedipalpi—while in the Spiders, in which both are present, it is the higher forms—the Dipneumones—which have tracheæ, affords a strong argument against it. It is said that the independent development of tracheæ so closely resembling each other in the Insects and Arachnids cannot be thought of as possible; but

* Arch. de Biol. vol. v.

if we attempt to begin from tracheæ we find that lung-books, more closely resembling each other, have to be independently developed twice, or more probably three times, so we are not much advanced. Further, the similarity between the tracheæ of Arachnids and Insects has been much overrated. It seems to depend mostly on the spiral thickening, which is present in both cases; but a thickening of some sort is evidently a mechanical necessity in these structures, and also the "spiral" is very poorly developed in many Arachnids. The difference of position, too, must have some morphological significance,—the tracheæ of Insects &c. arising outside the attachment of the appendages, while those of Arachnids are inside. Bernard * would derive the tracheæ of both forms from setiparous sacs, and makes a great point of the thoracic stigmata of *Galeodes*. *Galeodes* is a difficult problem, whichever view we take, but far too little is known of its anatomy (and still less of its development) to make it a safe basis for generalizing from. It is to be hoped that Dr. Bernard's forthcoming paper on this form will give us some surer ground on which to base our speculations. He talks of the "fascinating but seductive" hypothesis that the lung-books are derived from branchiæ; but it seems to me that a plentiful supply of setiparous sacs, capable of developing at will into lung-books, tracheæ, or coxal glands, affords a still more "fascinating" hypothesis, and is, I am afraid, equally seductive. I do not think that, in face of the development of the lung-books in *Phrynus*, where they evidently arise as foldings of the posterior wall of an appendage, it is possible to entertain the idea that they are derived from setiparous sacs, and they do not seem to give much indication of being derived from tracheæ. It is unfortunate that the development of the tracheæ in Arachnids has never been fully described, for I cannot but think that it would give some indication as to whether they are primitive or derived from lung-books †.

The Coxal Gland.

There can be little doubt now but that this structure is morphologically a nephridium. It has been shown to develop in part from the mesoderm, and in the earlier stages to open into

* Zool. Jahrb. vol. v., and Ann. & Mag. N. H. vol. xi. 1893.

† *Vide* Simmons, Am. J. Sci. Nat., Aug. 1894, and Ann. & Mag. N. H., Sept. 1894.

the cœlomic cavity in *Limulus*, *Scorpio*, *Phalangium*, and Spiders, and the structure in the adults is much the same in all these forms. Bernard * again suggests setiparous sacs as the origin of the coxal glands, but I do not think he can have understood the significance of what has been described in their development. Setiparous sacs, partly developed from the mesoderm and opening freely into the cœlom, do not commend themselves to one as morphological probabilities. The differences in the various forms have been so fully treated of by Sturany † that it seems unnecessary to recapitulate the details here. The one point on which I wish to lay some stress is the difference which exists as to the segment to which the coxal gland belongs. In the Scorpion and *Limulus* it opens at the base of the fifth pair of appendages. Kowalevsky and Schulgin ‡ describe it as belonging to the third in *Androctonus ornatus*; but my sections of *Euscorpius italicus* and *Centrurus* leave no possibility of doubt that in these forms it is the fifth, and as they themselves seem not very certain, I think it probable that they were mistaken. In *Phalangium*, *Phrynus* (*supra*), and Spiders this organ opens at the base of the third pair of appendages. Bertkau § says he has seen ducts to the fifth pair of appendages in *Atypus*, and Sturany says also that the gland opens on the fifth in the Tetrapneumones. In Pseudoscorpions it opens on the "third leg"—which, I presume, means the fifth pair of appendages—according to Bernard.

It seems, then, that while the coxal glands are serially homologous in different forms, they belong to different segments, and by this character alone the Arachnida would be divided into two sections—one containing the Scorpions and *Limulus*, in which the gland opens on the fifth appendages, and the other the rest of the group, in which there is a gland in the third segment, with the possible exception of some Spiders and Pseudoscorpions. A gland may also be present in the fifth segment in these forms. The antennary and shell-glands of Crustacea are no doubt structures of the same kind but belonging to different segments, *i. e.* either the second and fifth or first and fourth, according as one does or does not count the first antennæ as somatic appendages. Consequently,

* Ann. & Mag. vol. xii. 1893.

† Arb. Zool. Inst. Wien, vol. ix.

‡ Biol. Centralbl. vi.

§ Arch. mikr. Anat. vol. xxiv., and Zool. Anz. xcii.

we must regard both the Crustacea and the two sections of Arachnida as having for their common ancestor a form with nephridia in each segment.

The Gut.

The only point on which I wish to make a few remarks in this connection is the origin of the stercoral pocket as I have described it above. There is no doubt in my mind that in *Phrynus* it is formed from the mesenteron. The position of the Malpighian tubes, which I discovered after I had completed the section dealing with *Phrynus*, as running in close contact with the wall of the stercoral pocket, to open into it at its posterior end, is absolutely conclusive, though the evidence from histological structure and anatomical relations in *Phrynus* and *Thelyphonus* was pretty strong already. In Spiders, however, it is always described as being formed from the proctodæum; and the question arises whether the stercoral pocket in Spiders is not analogous with that of Pedipalpi, or whether the development has not been properly described. I incline to the latter view. That the development of this part of the gut is not quite straightforward is, I think, evident from the fact that Kishinouye *, in his elaborate paper on the development of Araneina, describes it as formed from the unpaired caudal cœlom. Such a startling suggestion as this certainly requires independent confirmation, and I think that possibly Kishinouye has mistaken the early formed posterior part of the gut for cœlom. However this may be, Kishinouye's figures seem to make it pretty clear that the stercoral pocket has no connection with the proctodæum, which at this stage is represented by a solid plug of cells, just as it is in *Phrynus*. The formation of the Malpighian tubes in the Spider has also never been quite satisfactorily described, and if they run in close contact with the stercoral pocket, as they do in *Phrynus*, they might easily be mistaken as opening into the anterior end of the pocket. Kishinouye admits that he is not satisfied with his observations on the origin of these structures, and the description by other observers is hardly more satisfactory than his. Locy's description † is brief, and his figures are capable of a different interpretation to that which he gives them: fig. 57, in particular, seems rather in favour

* Journ. Coll. Sci. Jap.

† Bull. Mus. Comp. Zool. Harvard, xii.

of my view. Balfour* gives a very short account of this region, and does not say whether the stercoral pocket is formed from the proctodæum or not; and Morin gives no figures, and his account is brief and inconclusive. The point at all events will bear re-investigation.

Conclusion.

The ultimate summing-up of all morphological work is its embodiment in a classification which shall express the true relations of forms to each other. This I do not feel prepared to do as regards the Arachnids; but a few points may be touched upon. I have elsewhere † given some reasons for dividing the terrestrial forms into two subclasses similar to those suggested by Pocock ‡, and for considering the Scorpions as more nearly related to *Limulus*, and the rest of the Arachnids to the Eurypterids. A further argument may be found in the apparently invariable presence of a coxal gland on the third appendage in the latter section. The development of lung-books from branchiæ twice over would seem the chief difficulty in this view; but if, as I have tried to show, the first lung-books of Pedipalpi are equivalent to the pectines of Scorpions, the same difficulty faces us if we try the old hypothesis.

The mutual relations of the forms constituting the second subclass (termed by Pocock "Lipoctena") is not quite clear. That the Arachnids and Pedipalpi are closely related is evidenced by their possession of two pairs of respiratory organs, a stercoral pocket, similar chelceræ, legs segmented in the same way, and a not very different disposition of the eyes. Beyond these two the different orders do not seem to show any very special relations to each other, and one is met at the outset by the difficulty concerning tracheæ. These are the common possession of the Phalangidæ, Spiders, Pseudoscorpions, and *Galeodes* That the tracheæ of Spiders have developed within the limits of that order is, I think, indisputable, as the Tetrapneumones, or at all events *Liphistius*, must be admitted as being the lower forms. But no possible arrangement enables one to derive the Phalangidæ, Pseudoscorpions, and *Galeodes* from the Dipneumones without violating every rule of morphological probability. It must be

* Q. J. M. S. xx.
† Trans. R. S. Edinb. vol. xxxvii.
‡ Ann. & Mag. Nat. Hist. vol. xi.

admitted that tracheæ have been formed from lung-books twice at least within the limits of the Arachnida. As I have already pointed out, any attempt to derive lung-books from tracheæ lands one in an equally awkward position. The three remaining orders—Phalangids, Pseudoscorpions, and Solifugæ—are unfortunately the three about whose morphology we know least. They seem absolutely marked off from each other—the Phalangidæ by their extraordinary reproductive apparatus; the Solifugæ by the segmentation of the carapace and the presence of thoracic stigmata; and the Pseudoscorpions by the absence of both of these sets. For these reasons I have refrained from attempting to construct a phylogenetic tree in this place, as it seems useless to try any arrangement of the Lipoctena (Pocock) until more is known both of their structure and development.

EXPLANATION OF THE PLATES.

Plate III.

Fig. 1. *Thelyphonus*, opened from the dorsal surface. The superficial muscles of the thorax have been removed. i.–vi., appendages; *c.o.*, caudal organ; *d.c.m.*, dorsal tail-muscle; *d.v.m.s.*, dorso-ventral muscle of eighth free segment; *g*, thoracic expansion of gut; *ht.*, heart; *o.c.*, central eyes.

1 *a*. Portion of trabecular tissue from anterior lobe of gut.

2. Transverse section of thorax of small *Thelyphonus*. *cox.*, coxal gland; *ent.*, entostermite; *g* and *g'*, diverticula of gut; *m.d.g.*, anterior median diverticulum of gut; *n.g.*, thoracic nerve-ganglion; *st.*, stomodæum.

2 *a*. Transverse section through stomodæum in front of fig. 2.

3. Stercoral pocket and proctodæum.

4. Thorax after removal of the gut. *c.e.*, cerebral ganglia; *cox.*, coxal gland; *cox.d.*, duct of coxal gland; *ent.*, entosternite.

5. Cerebral and thoracic ganglia. iii.–vi., nerves to appendages; *oc.*, optic nerves; *oes.*, œsophagus.

6. Posterior portion of abdomen after removal of gut and digestive gland. *n.g.*, nerve-ganglion; *r.*, rectum; *l.s.s.* and *r.s.s.*, left and right sacs of stink-gland; *s.g.*, coiled tubes of stink-gland.

6 *a*. Section through part of wall of stink-sac.

7. Section through caudal organ. *cu.*, cuticle; *hy.*, hypodermis; *s.c.*, sense-cells.

8. Anterior segments of abdomen. The anterior process of the second sclerite has been removed so as to open the genital vestibule. c^1 and c^2, chitinous supports of the genital vestibule; *ge.v.*, genital vestibule; *lb.* 1 and *lb.* 2, first and second lung-books; *se.v.*, dilatation of vas deferens; *x*, hard structure in *se.v.*

Plate IV.

Fig. 9. Section of the free edges of two lamellæ of the lung-book.
10. Section through lamellæ of lung-book near their base.
11. Part of the wall of the air-space towards the centre.
12. Section of wall of air-space towards the side.
13. Side view of mouth and surrounding parts. The left first and second appendages have been removed and the thorax laid open. i. and ii., right first and second appendages; *car.*, carapace; *eps.*, epistome; *m.*, mouth; *p.s.t.*, sense-organ on base of appendage ii.
14. Ventral sclerites of second and third free segments, viewed from inside.
15. Section of wall of stercoral pocket.
16. Section of one of the Malpighian tubes.
17. Section of epithelium of proctodæum.

Plate V.

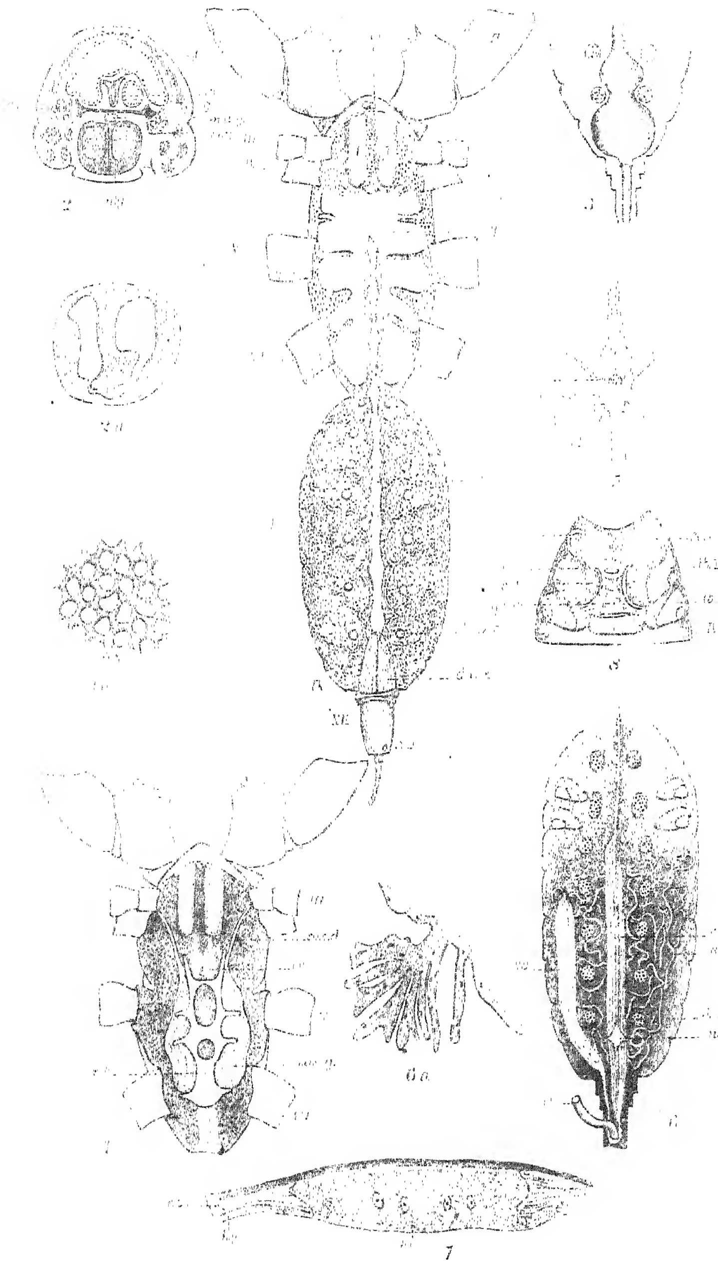
Fig. 18. Ventral surface of abdomen of *Phrynus reniformis*, with egg-sac.
19. Young embryo of *Phrynus reniformis*: surface view.
20. Side view of embryo of *Phrynus annulatipes*, $\times 9$. *l.o.*, lateral organ.
21. Schematic longitudinal vertical section of *Phrynus annulatipes*, $\times \frac{16}{1}$. *o.c.*, median eye; *gen.a.*, genital aperture; *Stc.*, stercoral pocket; *Pr.*, proctodæum.
22. Longitudinal section of first four abdominal segments. $\times \frac{44}{1}$.
23. Longitudinal section through front part of coxal gland and duct.

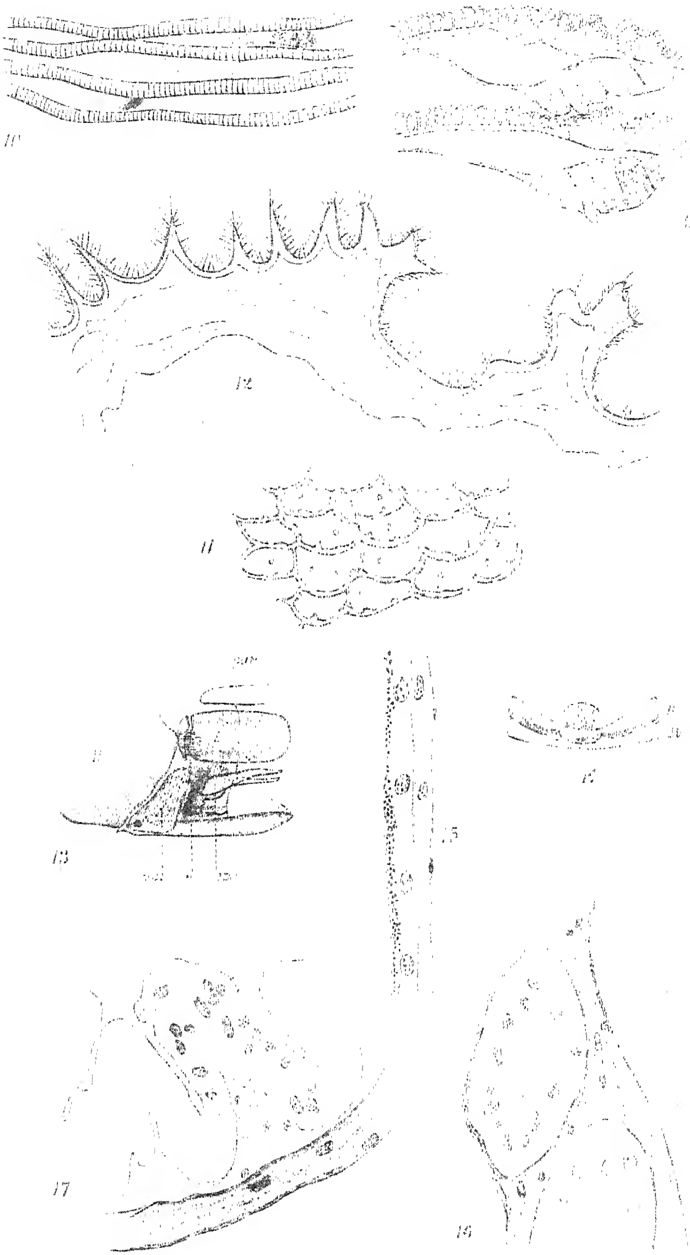
On the Aortic-Arch System of *Saccobranchus fossilis*. By R. H. Burne, B.A. Oxon., Assistant in Museum, Royal College of Surgeons, London. (Communicated by Prof. G. B. Howes, F.L.S.)

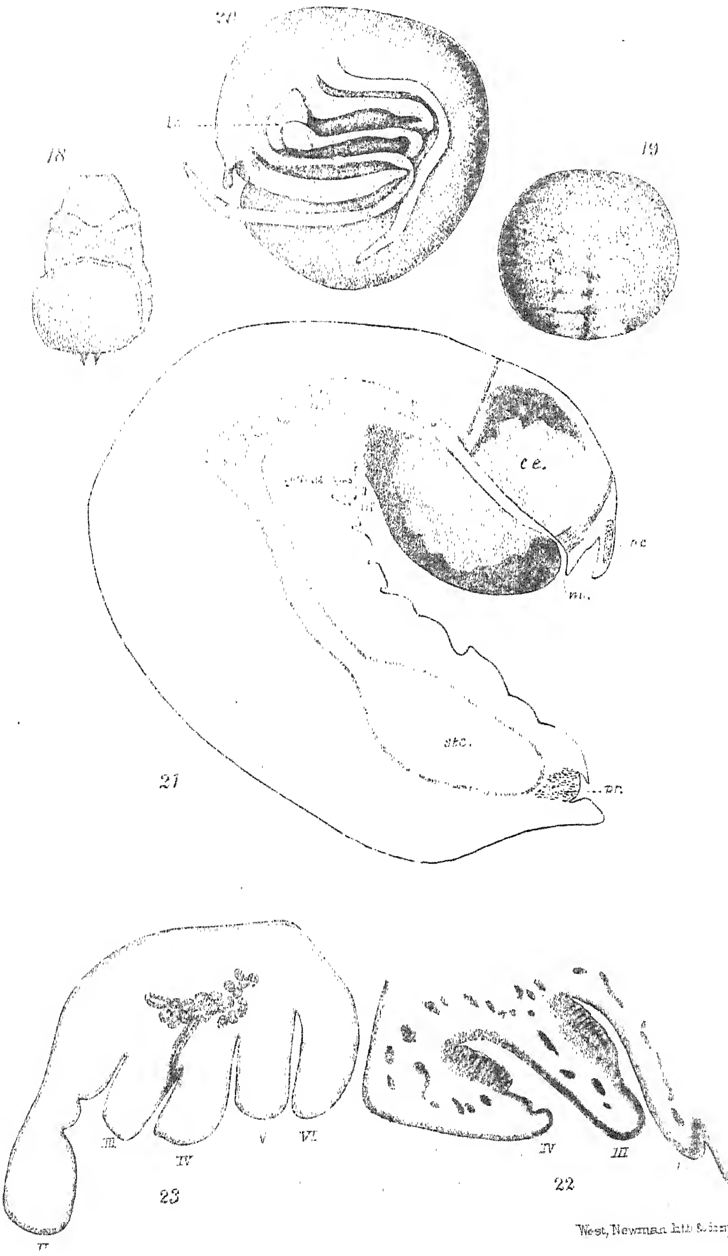
[Read 5th April, 1894.]

In tropical countries, but more especially in India, where the streams and tanks are liable to become dry in the hot season, a number of the freshwater fishes have acquired the power of living for a longer or shorter time out of water, and are thus enabled either to migrate to places where water is more abundant, or to bury themselves deep down in the mud to await the revivifying rains. Many years ago * reports that fish were often dug up in spots that had been dry for months, or were found

* For the early literature of this subject see Boake, Journ. Ceylon Branch Asiat. Soc. 1865, and Day, Proc. Zool. Soc. 1868, p. 274.




10
9
12
11
13
15
14
17
16



West, Newman lith. & imp.

wandering far from any water, stirred the curiosity of naturalists, and finally led to the recognition, as accessory respiratory organs, of certain structural modifications occurring in these fishes.

For some time the exact method by which this respiration was effected remained doubtful. However, during the last twenty-five or thirty years numerous interesting experiments have been performed by Day and others * upon most of these Indian freshwater fishes, which tend to prove that the modifications in the pharyngeal region of these creatures (epibranchial and other organs) do not contain water for moistening the gills as was originally supposed, but air for purposes of direct aerial respiration †. In certain other air-breathing fishes, *i. e.* the bony Ganoids and the Dipnoi, the same end is attained by a modification of the swim-bladder.

Further details upon this subject are unnecessary, as my object is merely to draw attention to the fact that among fishes bearing no close relationship to each other there are to be found specialized organs differing in their morphological characters, but which are all, physiologically speaking, lungs.

In the East-Indian rivers there is to be found a curious air-breathing Siluroid, by name *Saccobranchus*, in which the accessory respiratory organ takes the form of a pair of long narrow air-pouches, which lie along the back on either side of the vertebral column above the transverse processes, and extend for three parts the length of the fish, from the branchial chamber to within four inches of the tail. Venous blood is conveyed directly from the heart to the air-sacs by branches of a pair of the afferent branchial arteries, and returned, after oxygenation, into the aorta.

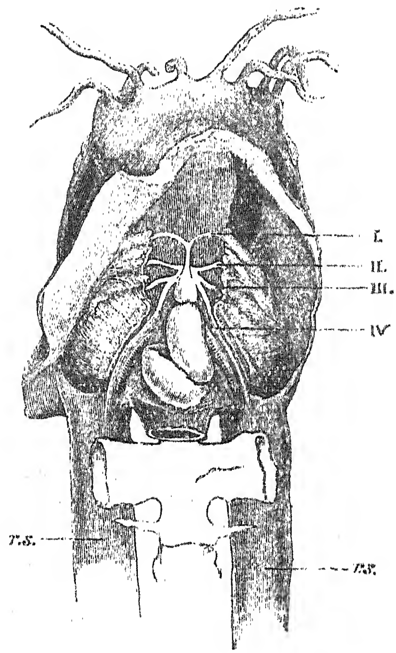
Hyrtl ‡, who has worked out the anatomy of this fish, describes the arrangement of the branchial arteries with reference to the air-sacs as follows :—" The fourth left branchial artery surpasses

* Day, Proc. Zool. Soc. 1868, p. 274, and Journ. Linn. Soc. (Zool.) vol. xiii. p. 198; Dobson, Proc. Zool. Soc. 1874, p. 312.

† From his researches on the blood-supply to the supra-branchial chamber in the Ophiocephalidæ, Hyrtl considers that this organ is not for breathing air, but is probably a water-reservoir for moistening the gills. (Hyrtl, " Ueber das Labyrinth und die Aortenbogen der Gattung *Ophiocephalus*," Sitz. Akad. Wiss. Bd. x. 1853, p. 148.)

‡ Hyrtl, " Zur Anatomie von *Saccobranchus singio*," Sitz. Akad. Wiss. 1853, Bd. xi. Heft 1, p. 302.

all the others on the same side in magnitude. The right, on the contrary, is smaller than all preceding it on its side. The left fourth branchial artery leaves the fourth gill-arch to pass to the ventral wall of the dorsal respiratory sac, on which it passes to the hinder end of the sac, giving off alternating side-twigs. On the right, the artery passing to the respiratory sac is not a prolongation of the fourth, but of the first branchial artery, and runs not on the ventral, but on the dorsal wall of the sac." This statement of Hyrtl's is endorsed by Hubrecht*, who dissected one of these fishes at the request of Day when the latter was working at the physiology of this apparatus.



Branchial region (nat. size) of *Saccobranchus fossilis*, showing the arrangement of the branchial arteries, seen from the ventral aspect.—I, II, III, IV, branchial arteries; *r.s.*, respiratory sacs.

In a specimen of *Saccobranchus fossilis* in the Museum of the Royal College of Surgeons (No. 1061 G), which I dissected last year, the branchial arteries do not answer to this description, for here the arteries are quite symmetrical on either side. The

* Day, Journ. Linn. Soc. (Zool.) vol. xiii. p. 198.

fourth on both sides is considerably larger than the others, and, after coursing along the fourth gill-arch, is continued upon the ventral wall of its respective air-sac. The first, second, and third go to their several gills in the ordinary way. The first on the right does not differ in size from its companion on the left, and rapidly diminishes in calibre in its course along the gill, so that I was unable to trace it more than half an inch or so.

Unfortunately it was not possible to inject this fish; but the vessels were sufficiently conspicuous to leave no doubt in my mind as to the accuracy of this observation.

It is to be observed that Hyrtl made his observations upon *Saccobranchus singio*, so that it is possible that this distribution of the branchial vessels may have a specific significance, and not be merely a case of individual variation.

With reference to this arrangement of the aortic arches in *Saccobranchus*, it is interesting to briefly review the work that has already been done in connection with the blood-supply to organs of aerial respiration in fishes and the higher Vertebrata.

Beginning at the top of the scale and working downwards, we find that a general law has been laid down by Boas * to the effect that in the Amphibia and all higher Vertebrata the pulmonary artery is always derived from the fourth branchial aortic arch †.

This generalization is considerably strengthened by van Bemmeln's ‡ discovery in embryonic Reptilia and Aves of two gill-clefts and an aortic arch lying between the systemic and pulmonary arteries; and still further by Zimmermann's § demonstration of an aortic arch in the same position in embryos of the rabbit and Man.

Coming now to the Dipnoi, amphibious fishes whose swim-bladder has been modified for purposes of aerial respiration, matters become complicated by the reduction and compression of the branchial apparatus. It is possible, however, in *Ceratodus*,

* Boas, Morph. Jahrb. Bd. vii. 1882, p. 488, "Ueber den Conus Arteriosus und die Arterienbogen der Amphibien;" and Morph. Jahrb. Bd. xiii. 1887–88, p. 115, "Ueber die Arterienbogen der Wirbelthiere."

† That is, the 6th visceral aortic arch. For simplicity's sake I count from the 1st branchial aortic arch.

‡ Van Bemmeln, "Die Visceraltaschen und Aortenbogen bei Reptilien und Vögeln," Zool. Anzeig. 1886, pp. 528 & 543.

§ Zimmermann, "Ueber einen zwischen Aorten- und Pulmonatbogen gelegenen Kiemenarterienbogen beim Kaninchen," Anatomisch. Anzeig. 1889, p. 720.

the member of the family least modified in this respect, to make out that the swim-bladder is supplied from the fourth aortic arch*. In *Protopterus* † this is no longer possible, as the efferent branchial vessels have become fused on either side into a common trunk, from the posterior face of which the pulmonary artery arises. The branchial compression is still more advanced in *Lepidosiren* ‡, the remaining member of the family; so much so indeed, that the pulmonary artery apparently takes its origin from the third aortic arch. Whether this is really the case I must leave an open question, although the great resemblance between the aortic arches in this fish and in some of the lower Amphibia § would incline one to think not.

In the two Ganoids *Polypterus* and *Amia* ‖ the pulmonary artery takes its origin, according to Boas ¶, as a large branch of the fourth efferent branchial vessel. The main trunk of this vessel, after giving off the pulmonary artery, passes on in a reduced condition, and joins the third efferent branchial vessel. Thus Boas regards the pulmonary artery of these fish as a derivative of the fourth branchial aortic arch alone.

In contradiction to this, it appears, from the figure of the aortic arches of *Amia* given by Ramsay Wright, that the third aortic arch is also involved in the formation of the pulmonary artery. This effect is produced by the connection between the third and fourth efferent branchial vessels being represented as a branch of the third, and not a continuation of the fourth efferent branchial vessel. A very slight alteration in the drawing is enough to accomplish this; for if the connection in question is drawn sloping from the third branchial vessel towards the middle line, it appears to be part of the third arch; if away from the middle line ever so slightly, it would be called a continuation of the fourth arch.

* Boas, Morph. Jahrb. Bd. vi. 1880, p. 321, "Ueber Herz und Arterienbogen bei *Ceratodus* und *Protopterus*."

† Parker (W. N.), "On the Anatomy and Physiology of *Protopterus annectens*," Trans. Roy. Irish Acad. vol. xxx., in which paper other references will also be found.

‡ Hyrtl, *Lepidosiren paradoxa*, and Bischoff, "Sur le *Lepidosiren paradoxa*," Ann. Sci. Nat. (Zool.) vol. xiv. 1840, p. 116.

§ Bischoff, *l. c.*

‖ Johannes Müller, "Beiträge zu Bau und Grenzen der Ganoiden," Abhandl. Akad. Wiss. Berlin, 1844, p. 117; Boas, Morph. Jahrb. Bd. vi. p. 321.

¶ Boas, Morph. Jahrb. Bd. vi. pp. 342 & 351.

Having regard to the fact that Ramsay Wright's figure is a diagram in the Introduction to a General Natural History of Fishes' *, but that Boas, on the other hand, was working specially upon the aortic arches of these Ganoids, it seems to me that we are justified in electing to follow Boas in this matter, and, with him, to look upon the pulmonary artery of *Polypterus* and *Amia* as a derivative of the fourth aortic arch alone †.

Finally, we come to the mixed group of tropical freshwater fishes in which a modification of the pharyngeal region does duty as a lung. The anatomy of the epibranchial organ of the Labyrinthici has been worked out by Zograff ‡; and as regards the blood-supply to that structure, he succeeded, after several disappointments, in proving that the blood is brought to the epibranchial organ by the fourth aortic arch.

The suprabranchial chamber of the Ophiocephalidæ, which so much resembles that of the Labyrinthici, according to Hyrtl does not receive its blood from the heart, although the fourth branchial artery passes through it. From the subsequent experiments that have been performed on these fishes, it is very probable that Hyrtl was mistaken, and that these chambers are organs for the respiration of air. In this connection it is well to remember that Zograff found great difficulty in injecting the blood-vessels to the epibranchial organ in the Labyrinthici.

Now, as to *Saccobranchus*, we have seen that Hyrtl and Hubrecht found that the blood was carried to the respiratory sacs by the first aortic arch on one side, and the fourth on the other. In my specimen, on the contrary, it was supplied by the fourth on both sides.

The peculiar spirally-coiled epibranchial organ of *Heterotis Ehrenbergii*, one of the Osteoglossidæ §, receives its blood from the fourth aortic arch, as also does that of *Chanos salmonæus* (*Lutodeira chanos* of Hyrtl) ‖. In the Cuchia eel, *Amphipnous*

* Ramsay Wright, 'Standard Natural History,' vol. iii. p. 48.

† Boas, Morph. Jahrb. Bd. vi. pp. 342 & 351.

‡ Zograff, Quart. Journ. Micros. Sci. vol. xxviii. 1888, p. 501, "On the Construction and Purpose of the so-called Labyrinthine Apparatus of the Labyrinthic Fishes."

§ Hyrtl, Denkschr. Akad. Wiss. Bd. viii. 1854, p. 73, "Beitrag zur Anatomie von *Heterotis Ehrenbergii*."

‖ Hyrtl, "Ueber das Epigonale Kiemenorgan von *Lutodeira chanos*," Denkschr. Akad. Wiss. Bd. xxi. 1863, p. 1.

cuchia *, the two respiratory bladders on either side of the neck obtain their blood-supply from the first pair of branchial aortic arches.

In looking through the above list, one is at once struck by the frequency with which the pulmonary artery is derived from the fourth aortic arch; and this not only when the lungs are in all probability homologous structures, but in creatures having different kinds of air-breathing organs, some of which can bear no morphological relationship to each other.

There certainly are exceptions, but they are comparatively very few; in fact, even including *Lepidosiren*, which, from the compressed condition of its branchial apparatus, ought scarcely to be used as an argument either way, they only amount to three; and even of these three we have seen that one, i. e. *Saccobranchus*, is sometimes found in what may be called the normal condition.

The general tendency appears to be that any organs modified to act as lungs, no matter what may be their morphological characters, are supplied with blood by the fourth branchial aortic arch. In the higher Vertebrata this is the case without exception; and even among fishes, where presumably the organ specialized for breathing air is not so firmly established, this is still the case, although liable to variation.

Saccobranchus and *Amphipnous* agree in respect to the origin of their afferent pulmonary vessel from the afferent branchial system; and therefore it is specially interesting to note that *S. singio* is abnormal in the partial realization of that character (origin of pulmonary artery from the first branchial arch) which is diagnostic of *Amphipnous*.

It has been suggested to me by my friend and late teacher Prof. Howes, that the variations occurring in the pulmonary artery of these fishes may find a parallel in the variability which he observed in the first appearances of the epiglottis in the Amphibia *. So far as I am aware, this may very well be the case, since there appears to be considerable liability to variation in organs that are in the initial stages of their development, and, so to speak, still on their trial.

* Hyrtl, "Ueber den Amphibienkreislauf von *Amphipnous* und *Monopterus*," Denkschr. Akad. Wiss. Bd. xiv. 1857, p. 39.

† G. B. Howes, "On a hitherto unrecognized Feature in the Larynx of the Anurous Amphibia," P. Z. S. 1887, p. 491.

I cannot conclude without tendering my warmest thanks to Prof. Howes for the trouble he has taken in helping me with this paper, and for many kindly suggestions and corrections.

NOTE (25 *Sept.*, 1894).—Since writing the above, my attention has been called to two short papers by Jobert on the aerial respiration of certain fishes of the Amazon (Ann. Sci. Nat. sér. 6, vol. v. art. 8, & vol. vii. art. 5). In three instances (*Callichthys*, *Hypostomos*, and *Doras*) aerial respiration is effected by means of a peculiarly modified portion of the intestine which receives its blood-supply from the aorta; the blood, however, is partly venous, as the afferent and efferent branchial vessels are continuous and allow the blood to pass directly from one to the other. In the case of two other fishes (*Erythrinus* and *Sudis*) the swim-bladder functions as a lung, receiving venous blood from the mesenteric veins, and also arterial blood from the aorta. It will be noticed that all these fishes, as regards their pulmonary blood-supply, are exceptions to the general tendency indicated above: that this should be so, especially in the case of the intestinal breathers, is not a matter for surprise; here, if anywhere, one would expect to find variation, for the distance of the modified organ from the pharynx suggests the probability that the blood-supply to the newly acquired lung might be procured from some already existing neighbouring vessel, rather than directly from the distant aortic arch.—*R. H. B.*

Report upon the Parasitic Hymenoptera of the Island of St. Vincent. By C. V. Riley, W. H. Ashmead, and L. O. Howard. (Communicated by D. Sharp, F.L.S., on behalf of the Committee for Investigating the Flora and Fauna of the West-Indian Islands.)

[Read 29th June, 1893.]

Introduction. By C. V. Riley.

When the parasitic Hymenoptera and Rhynchota collected by Mr. Herbert H. Smith in the island of St. Vincent were sent to me some time ago by the West India Committee for study, I hoped to find time to work upon the collection myself, particularly in certain groups in which I have long taken an especial interest. This hope has proved vain, owing to the pressure of more urgent duties. While, however, I have been able to do but comparatively little work myself, I take pleasure in transmitting herewith a Report on the parasitic Hymenoptera by two of my assistants, Messrs. W. H. Ashmead and L. O. Howard, both of whom are well-known workers in this group of insects. Mr. Ashmead has studied the Braconidæ, Ichneumonidæ, Proctotrypidæ, and part of the Chalcididæ, the latter family possessing the largest number of forms. Mr. Howard has taken up the remainder of the Chalcididæ, comprising the subfamilies *Chalcidinæ*, *Eucharinæ*, *Perilampinæ*, *Encyrtinæ*, *Elasminæ*, *Aphelininæ*, *Pireninæ*, and *Elachistinæ*. Six new genera and 299 new species are characterized. I have myself studied but have not yet completed the work on the *Microgasterinæ* in the Braconidæ, and the *Eupelminæ* in the Chalcididæ; and hope to send before long a supplementary Report on these subfamilies.

The material collected by Mr. Smith has proved to be of very considerable interest. The groups containing the smaller Hymenoptera have been so little collected, especially in the western hemisphere, that generalizations bearing upon the geographical range of species can hardly be attempted as yet, and such generalizations as may be made will have little value. It is interesting to note, however, that although the very large majority of the forms are new to science, a number of the old species collected in this island by the Rev. Lansdown Guilding during his residence there, and subsequently described by Francis

Walker, have been refound. A few of the old Fabrician species have also been recognized, while a number of forms common within the limits of the United States are also contained in the collection. These last are evidently species of wide distribution, since the characteristic fauna of St. Vincent must much more nearly resemble that of northern South America than of North America, or even of the subtropical portion of the Floridian peninsula.

It will appear from the portion of the Report contributed by Mr. Ashmead that nine of the species are common to St. Vincent and the United States, six occurring in the State of Florida, while the other three have a more northern range. In the Chalcidids studied by Mr. Howard nearly three fourths are new, although not necessarily of subtropical limits. Nine of the previously described forms are characteristically tropical or subtropical; one, curiously enough, has never before been found except in North Europe, and must evidently be considered an introduced species in St. Vincent; while four are North American, two being found commonly throughout the United States, one only in the district of Columbia, and one in Florida. The following list is, I believe, a fairly complete one of the previously described parasitic Hymenoptera found on the island of St. Vincent, those marked with a * having been previously reported, while those without the * are now recorded for the first time from the collection on which Messrs. Ashmead and Howard have reported; so that with the descriptive papers the list will comprehend all the parasitic Hymenoptera so far known from the island.

List of previously described Parasitic Hymenoptera found in St. Vincent.

Family CYNIPIDÆ.

Subfamily EUCOILINÆ.

EUCOILA, *Westwood.*

E. basalis, Cr. Proc. Ent. Soc. Phil. iv. p. 5.

EUCOILIDEA, *Ashmead.*

E. canadensis, Ashm. Trans. Am. Ent. Soc. xiv. p. 154.

Subfamily FIGITINÆ.

SOLENASPIS, *Ashmead.*

S. bifoveolata, Cr. (*Aspicera*), Proc. Ent. Soc. Phil. iv. p. 7.

Family BRACONIDÆ.

Subfamily SPATHINÆ.

STENOPHASMUS, *Smith.*

(?) *S. pusillus*, Cr. Proc. Ent. Soc. Phil. iv. p. 85.

Subfamily HECABOLINÆ.

HETEROSPILUS, *Haliday.*

**H. quæstor*, Hal.

Subfamily AGATHIDINÆ.

MICRODUS, *Nees.*

M. varipes, Cr. Proc. Ent. Soc. Phil. iv. p. 65.
M. stigmaterus, Cr. *l. c.* p. 65.

Subfamily ALYSIINÆ.

ALYSIA, *Latr.*

A. analis, Cr. Proc. Ent. Soc. Phil. iv. p. 88.

Family ICHNEUMONIDÆ.

Subfamily OPHIONINÆ.

OPHION, *Fabr.*

O. flavum, Fab. Ent. Syst. ii. p. 179.
O. concolor, Cr. Proc. Ent. Soc. Phil. iv. p. 56.
O. cubensis, Nort. *l. c.* p. 56.

EIPHOSOMA, *Cresson.*

E. annulator, Cr. *l. c.* p. 54.

Family EVANIIDÆ.

GASTERUPTION, *Latr.*

**G. Guildingii*, Westw. Trans. Ent. Soc. Lond. 1851, p. 219.
**G. rufipectus*, Westw. *l. c.* p. 219.

EVANIA, *Fabr.*

E. appendigaster, Linn. Syst. Nat. i. p. 943.

Family CHALCIDIDÆ.

Subfamily Eucharinæ.

Kapala, *Cameron.*

K. furcata, Fabr. Syst. Piez. p. 158.

Orasema, *Cameron.*

O. stramineipes, Cam. Biol. Cent.-Am., Hymen. i. p. 105.

Subfamily Eurytominæ.

Decatoma, *Spinola.*

**D. oretilia*, Walk. Ann. & Mag. N. H. xii. p. 46.

Isosomodes, *Ashmead.*

I. gigantea, Ashm. Trans. Am. Ent. Soc. Phil. xiii. p. 127.

Subfamily Chalcidinæ.

Spilochalcis, *Thomson.*

S. femoratus, Fabr. Syst. Ent. p. 375, no. 10 (1775).
**S. fulvescens*, Walk. Ent. Mag. ii. p. 25.

Chalcis, *Fabr.*

C. annulatus, Fabr. Syst. Piez. p. 167.

Notaspis, *Walk.*

**N. formiciformis*, Walk. Ent. Mag. ii. p. 37.

Antrocephalus, *Kirby.*

A. punctigerus, Fabr. Syst. Piez. p. 167.

Subfamily Blastophaginæ.

Idarnes, *Walk.*

**I. carme*, Walk. Ann. & Mag. N. H. xii. p. 47.

Paphagus, *Walk.*

**P. sidero*, Walk. *l. c.* p. 48.

Subfamily Spalangiinæ.

Spalangia, *Latr.*

S. nigra, Latr. Gen. Crust. et Ins. iv. p. 29.
S. drosophilæ, Ashm. Trans. Am. Ent. Soc. Phil. xiv. 1887, p. 199.

Isocratus, *Förster.*

I. vulgaris, Walk. Ent. Mag. x. p. 114.

Subfamily PTEROMALINÆ.

CYRTOGASTER, *Walk.*

C. vulgaris, Walk. Ent. Mag. i. p. 382.

LELAPS, *Haliday.*

**L. pulchricornis*, Hal. Ann. & Mag. N. H. xii. p. 47.

STENOMALUS, *Thomson.*

S. muscarum, Walk. Brit. Mus. Cat. p. 42.

CATOLACCUS, *Thomson.*

**C. helice*, Walk. Ann. & Mag. N. H. xii. p. 46.

Subfamily ENCYRTINÆ.

ÆNASIUS, *Walk.*

**Æ. hyettus*, Walk. Ann. & Mag. N. H. xvii. 1846, p. 181.

COMYS, *Förster.*

C. bicolor, How. U. S. Agric. Rep. 1880, p. 362, pl. 23. fig. 3.

LEPTOMASTIX, *Förster.*

L. dactylopii, How. Bull. V., Ent. Bur. U. S. Dept. Agric. p. 23.

ENCYRTUS, *Dalman.*

E. tiliaris, Dalman, Kongl. Vet. Akad. Handl. 1820, p. 171.

Subfamily APHELININÆ.

COCCOPHAGUS, *Westwood.*

C. Lecanii, Fitch, How. U. S. Agric. Rep. 1880, p. 360.

Subfamily ELACHISTINÆ.

EUPLECTRUS, *Westwood.*

**E. furnius*, Walk. Ann. & Mag. N. H. xii. p. 48.

STENOMESIUS, *Westwood.*

S. platynotæ, Howard in Hubbard's 'Orange Insects,' 1885, p. 217.

Subfamily EULOPHINÆ.

HOPLOCREPIS, *Ashmead.*

H. albiclavus, Ashm. Proc. Ent. Soc. Wash. i. p. 235.

It may be well to call particular attention to the use of the generic name *Ashmeadia* by Mr. Ashmead in the opening portion of his section on the *Eurytominæ*. In the 'Canadian Entomologist' during the closing months of 1889 Messrs. Ashmead and Howard discussed the priority of the use of the generic name *Rileya*, Mr. Howard having proposed it for a peculiar Encyrtine genus from California almost simultaneously with Mr. Ashmead's use of the same name for a Eurytomine genus from Florida. Mr. Howard, considering *Rileya*, Ashmead, to be a synonym of his own genus of the same name, proposed for the former the name *Ashmeadia*. With a view of ending a useless controversy, Mr. Ashmead, upon an expression of my own view, has consented to recognize *Ashmeadia* for the Eurytomine genus, leaving Mr. Howard's Encyrtine genus in possession of the name *Rileya*. In dedicating genera to individuals yet living, authors might avoid such possible conflict did they but first obtain the sanction of the person whom they intend to honour.

I cannot close these few notes of introduction without expressing my own sense of the obligation under which entomologists generally must rest to the West India Committee for carrying on this series of investigations; and as the insect fauna of island after island is studied, the value of the results will proportionately increase.

Report on the Parasitic Cynipidæ, *part of the* Braconidæ, *the* Ichneumonidæ, *the* Proctotrypidæ, *and part of the* Chalcididæ.—PART I.* By WILLIAM H. ASHMEAD.

Family CYNIPIDÆ.

Subfamily EUCOILINÆ.

DIGLYPHOSEMA, *Förster*.

DIGLYPHOSEMA FLAVIPES, sp. n.

♀. Length $1\frac{3}{5}$ to 2 millim. Polished black; mandibles and palpi yellow; antennæ black or dark brown, the first joint yellow; legs, including coxæ, yellow. Head transverse, including the eyes a little wider than the thorax across from tegulæ to tegulæ,

* For Part II. see p. 108.

which is the widest part. Eyes large, oval, convex. Cheeks distinctly margined, the lower portion finely, closely punctate. Face smooth, with two impressed lines that start between the base of the antennæ and the eye and extend into the lateral sutures of the clypeus; there is also a grooved line separating the cheeks from the face. Antennæ 13-jointed, submoniliform, as long as the body, the joints decreasing in length toward the tips. Thorax with two furrows that start from the anterior angles of the mesonotum and converge and extend back to the base of the scutellum, forming a long wedge-shaped carina; these lines are not deeply impressed and are quite different from those in my genus *Eucoilidea*. Collar visible above as a sharp carina. Pronotum slightly impressed and finely aciculated or striated at sides. Mesopleura smooth, highly polished, except a depression and some striæ just beneath the tegulæ; it is separated from the mesopectus by a straight line, and again divided at its basal one-third by an impressed line running parallel with the mesopectal suture. Metapleura scratched. Scutellum deeply foveated at base; its cup large, elliptical, with an elliptical central depression, surrounded by a submarginal punctate line; the sides of the cup finely, closely punctate. Metathorax short, depressed at the middle, with a central keel and rather prominent posterior lateral angles. Wings hyaline, pubescent, the venation yellowish; the marginal cell is large and open along the margin, the second abscissa of radius slightly curved and double the length of the first. Abdomen polished black, slightly piceous along the venter, slightly compressed, its tip abruptly truncate, the tip of the hypopygium visible.

Hab. St. Vincent.

Described from three female specimens.

EUCOILIDEA, *Ashm.*

EUCOILIDEA CANADENSIS, *Ashm. Trans. Am. Ent. Soc.* vol. xiv. p. 154 (1887).

Hab. Canada; St. Vincent.

Four specimens are in the collection that cannot be distinguished from the type originally described from Canada. Three other specimens differ in having the legs entirely reddish yellow; while the four specimens have the coxæ and base of femora black.

AGLAOTOMA, *Förster.*

Four species that evidently belong to this genus may be recognized as follows :—

Females.

Species black, except sometimes the metathorax and abdomen basally .... 2.
Species more or less pale rufous or brown.
Pale rufous, the occiput dusky.
Antennæ longer than the body, the eight terminal joints very slightly thicker than the preceding, the last joint one half longer than the penultimate; cup of scutellum very small, narrowed into a carina anteriorly, its disk wholly foveated .... *A. pallida.*
Head black, thorax dark brown, abdomen, legs, and first four flagellar joints pale rufous.
Antennæ not longer than the body, the seven terminal joints slightly thicker than the preceding, the last joint one third longer than the penultimate; cup of scutellum elliptic, not narrowed into a carina anteriorly, its disk foveated, but divided into two parts by a transverse carina, the anterior part the larger.................................. *A. variabilis.*
2. Wholly black; legs and six basal joints of antennæ yellowish.
Antennæ much longer than the body, the seven terminal joints thicker than the preceding, the last joint a little shorter than the penultimate; cup of scutellum elliptic, not narrowed into a carina anteriorly, its disk areolated .... *A. longicornis.*
Metathorax, abdomen basally, and legs pale rufous or brownish yellow.
Antennæ scarcely longer than the body, the seven terminal joints thicker than the preceding, the last joint not longer than the penultimate; the cup of scutellum small, elliptic, not narrowed into a carina anteriorly, its disk smooth, polished, with a small fovea posteriorly .... *A. basalis.*

Males.

Species black .... 2.
Species pale rufous.
Third antennal joint slightly longer than the fourth, the joints beyond about four times as long as thick;

cup of scutellum elliptic, its disk smooth, with a small fovea posteriorly and about six submarginal punctures anteriorly .... *A. pallida.*

Head and abdomen black, the thorax piceous.

Third antennal joint not longer than the fourth, the joints beyond the fourth very slightly longer and thicker, about thrice as long as thick; cup of scutellum as in *pallida* .... *A. variabilis.*

2 Metathorax and legs yellowish.

Third antennal joint much longer than the fourth, thickened and curved, the joints beyond the fourth more than thrice as long as thick; cup of scutellum very small.................................. *A. basalis.*

AGLAOTOMA PALLIDA, sp. n.

♂ ♀. Length $1\frac{2}{5}$ millim. Pale brown, polished, the occiput, in the female, black. Face with some fine longitudinal lines along the orbits. Antennæ in female 13-jointed, as long as the body, very slightly and gradually thickened toward tips, the joints long, cylindric; the first joint of funicle is scarcely longer than the second: in male longer than the body, filiform, the joints all long, cylindric; the first joint of funicle is slightly longer than the second and slightly bent, the following are a little contracted at base and apex and all finely fluted. Thorax smooth, without furrows, the prothorax visible above as a sharp, transverse carina. Cup of scutellum in male elliptical, its dorsum with a submarginal row of punctures and a fovea behind; laterally it is closely punctulate: in the female the cup is very small, narrowed, and extends into a carina anteriorly. Mesopleura polished, the epimera separated, in the male smooth, in the female finely, longitudinally aciculated. Metapleura smooth, bounded by a carina posteriorly. Metathorax short, with lateral carinæ and slightly pubescent. Wings hyaline, fringed, the venation brown, the marginal cell closed; the second abscissa of the radius is only about one fifth the length of the first. Abdomen highly polished, in male dark brown above, pale along the venter, with a slight hairy girdle at base.

Hab. St. Vincent.

Described from two male and one female specimen.

The female of this species agrees exactly with Förster's definition of the genus, but the male disagrees in not having the first joint of funicle " bermässig verlängert."

Aglaotoma variabilis, sp. n.

♂ ♀. Length $1\frac{1}{2}$ to $1\frac{4}{5}$ millim. Polished, the head black, thorax brown; mandibles, four basal joints of flagellum, legs, and abdomen rufous, the latter blackish above; in the male the thorax is paler, the antennæ, except the three terminal joints, entirely black, the legs more yellowish. Antennæ in female 13-jointed, as long as the body, subclavate, all the joints long, cylindric, the seven terminal joints thicker than the preceding, black, but scarcely forming a distinct club; in the male 15-jointed, filiform, nearly twice as long as the body, all the flagellar joints about equal in length, those in the middle being slightly dilated. Scutellum profoundly foveated at base, with deep channels around the cup, the latter with a pale margin and impressed at base and apex; in the male the cup is slightly larger, its dorsum smoother, foveated posteriorly and with six submarginal punctures anteriorly. Wings hyaline, fringed, the venation brown; the marginal cell is about two and a half times as long as wide, closed, the second abscissa of radius about one half longer than the first, both slightly curved. Abdomen highly polished, scarcely longer than the thorax, with a woolly girdle at base.

Hab. St. Vincent.

Described from one male and one female specimen.

Aglaotoma longicornis, sp. n.

♀. Length 2 millim. Polished black; six basal joints of antennæ, mandibles, and legs reddish yellow. Antennæ 13-jointed, longer than the body, the flagellar joints all cylindric, but the seven apical joints thicker than the basal joints, black, fluted, and pubescent, a little more than thrice as long as thick; the four basal joints are very slender, the first slightly the shortest. Cup of scutellum elliptic, its dorsum areolated by irregular raised lines. Wings hyaline, fringed, the venation yellow; the marginal cell is very little more than twice as long as wide; the second abscissa of radius is about one third longer than the second, both slightly curved.

Hab. St. Vincent.

Described from a single specimen.

Aglaotoma basalis, sp. n.

♂ ♀. Length 1 millim. Polished black; five basal antennal

joints and legs yellow; mandibles, metathorax, and base of abdomen rufous. Sometimes the whole abdomen is black. Antennæ, in female, scarcely longer than the body, 13-jointed, cylindric, the seven apical joints slightly thickened, fuscous: in male 15-jointed, twice as long as the body, fuscous, the joints all fluted; the first flagellar joint is one third longer than the second, curved, clavate. The cup of the scutellum in the male is very small, narrowed; in the female larger, elliptic, its dorsum smooth, with a fovea posteriorly and some punctures anteriorly. Wings hyaline, fringed, the venation pale brown; the marginal cell is closed, about twice as long as wide, the abscissas of radius about equal in length, the first being slightly curved.

Hab. St. Vincent.

Described from one male and three female specimens.

GANASPIS, *Förster*.

This genus, as recognized here, comes close to *Aglaotoma*; but the antennæ in the female are shorter, clavate, the six or seven terminal joints enlarged, submoniliform, much as in *Hexacola*, from which it differs, however, in having a closed radial cell. In the male the first flagellar joint is scarcely longer than the second, not or only slightly curved.

The two species may be tabulated as follows:—

Entirely pale ferruginous or honey-yellow .... 2.
Pale ferruginous or honey-yellow, with the head black or fuscous.
  Six terminal joints moniliform, black, and, except the last, scarcely longer than thick.
    First funicle-joint twice as long as the second, the second and third equal, longer than thick, the fourth and fifth small, moniliform. ♀ .... *G. atriceps.*
  Three or four terminal joints black, and fully twice as long as thick.
    First funicle-joint very little longer than the second, the following all long, cylindric, thrice as long as thick. ♀ .... *G. apicalis.*
2. Antennæ 15-jointed, filiform, the three apical joints white. ♂ .... *G. apicalis.*
  Antennæ 13-jointed, the three apical joints fuscous. ♀ variety (?) .... *G. apicalis.*

GANASPIS ATRICEPS, sp. n.

♀. Length $1\frac{2}{5}$ millim. Pale ferruginous, polished, the head and six terminal antennal joints black; mandibles and palpi pale. Antennæ 13-jointed, not longer than the thorax, the club 6-jointed, the joints, except the last, scarcely longer than thick, black, delicately fluted; the first joint of funicle is twice the length of the second, the second and third equal, longer than thick, the fourth and fifth moniliform, not longer than thick. The scutellum at sides is finely rugose, its cup small, elliptic, with a small fovea posteriorly. Metathorax short, finely rugose, with a medial carina. Wings hyaline, fringed, the venation pale brown; the marginal cell is closed, a little more than twice as long as wide, the second abscissa of the radius being one third longer than the first, both slightly curved; cubitus visible. Abdomen not longer than the thorax, with the usual girdle at base.

Hab. St. Vincent.

Described from a single female specimen.

GANASPIS APICALIS, sp. n.

♂ ♀. Length $\frac{4}{5}$ to 1 millim. Pale ferruginous or honey-yellow; the head in the female most frequently black or fuscous, rarely entirely pale as in the male. Antennæ in female 13-jointed, about as long as the body, the six terminal joints enlarged, at least twice as long as thick, fluted, the three or four apical joints always black or fuscous; the first joint of funicle is cylindrical, a little longer than the second, the joints beyond, to the club, at least thrice as long as thick. In the male the antennæ are pale brown or slightly fuscous, 15-jointed, nearly twice the length of the body, with the three terminal joints always white. Scutellum at sides finely rugose; the cup in the male is small, arched, its dorsum smooth and polished, with only a small fovea posteriorly; in the female sometimes with two foveæ and sometimes with a fovea posteriorly and punctures anteriorly. Abdomen a little longer than the thorax, with a woolly girdle at base.

Hab. St. Vincent.

Described from several specimens.

From the difference observed above in the scutellar characters, I suspect this species may really represent two distinct species; but, as the specimens are hardly sufficient for me to determine

with certainty, I prefer for the present to let them remain together.

CHRESTOSEMA, *Förster*.

CHRESTOSEMA ROBUSTA, sp. n.

♂ ♀. Length $1\frac{1}{2}$ to $1\frac{4}{5}$ millim. A small, robust, polished black species. The head is transverse quadrate; the clypeus small, convex; mandibles and trochanters, tips of femora, tibiæ, and tarsi reddish yellow, the rest of the legs black. Antennæ in female filiform, submoniliform, shorter than the body, piceous, 13-jointed, the joints oblong-moniliform; the first funicle-joint is narrowed and slightly shorter than the second, the following joints are about the same thickness, but the five terminal joints are shorter than the five preceding: in the male longer than the body, filiform, the first funicle-joint is a little longer than the second, the following oblong-moniliform, about three times as long as thick. Thorax with two abbreviated, nearly parallel furrows anteriorly, that do not extend posteriorly quite to the middle of the mesonotum. The scutellum is separated from the mesonotum by deep foveæ; its cup is high, large, and almost round and centrally foveated, its sides vertically striated. Mesopleura smooth, with a small furrow below the tegulæ, the epimera separated, polished. Metapleura, except a small rugose space just above the coxæ, smooth, polished, the posterior margin carinated and pubescent, while on the disk is a faint impressed line. Metathorax very short, vertical, and closely punctate, with a delicate medial carina. Wings hyaline, the venation yellowish; the marginal cell is closed, short, not longer than wide, the second abscissa of the radius being scarcely longer than the first and slightly curved outwardly. Abdomen not longer than the thorax, polished black, a slight pubescent girdle at base and with its tip vertically truncate.

Hab. St. Vincent.

Described from one male and one female specimen.

CHRESTOSEMA PALLIDIPES, sp. n.

♀. Length $1\frac{1}{5}$ millim. Differs from the above in having the antennæ and legs, including the coxæ, entirely honey-yellow, although the tips of the antennæ are sometimes dusky; face with two grooved lines, each line extending from the base of the antennæ to the base of the eye; while the cup of the scutellum

has only a small fovea posteriorly, with a submarginal row of punctures, its sides being rugose, not vertically striated.

Hab. St. Vincent.

Described from two female specimens.

Kleidotoma, *Westwood*.

Kleidotoma insularis, sp. n.

♀. Length 1 millim. Polished black; legs rufous, the middle and posterior coxæ black, all the femora more or less dusky. Antennæ 13-jointed, black, the three terminal joints much enlarged, fluted, the last the longest; the basal joint is a little longer than the last, curved clavate, the second joint or the pedicel is oval; the following joints to the club are very slender; the third or the first joint of funicle is twice as long as the second, the joints following are rounded or moniliform and slightly increase in size. Wings hyaline, not emarginate at apex, the venation pale; the tip of the submarginal vein terminates in a quadrate stigma, the marginal cell is open along the outer edge and is nearly twice as long as wide, the first abscissa of radius very oblique, a little longer than the second. Abdomen as long as the thorax, polished, compressed, without a pubescent girdle at base and with a very finely aciculated spot at base above.

Hab. St. Vincent.

Described from one female specimen.

Tetrarhapta, *Förster*.

Tetrarhapta rufipes, sp. n.

♀. Length 1 millim. Polished black; antennæ and legs reddish yellow, the four terminal joints of antennæ enlarged, fluted, and fuscous. Antennæ 13-jointed, the first joint scarcely longer than the oval second; the funicle-joints are slender, cylindrical, the first joint one third longer than the second, the joints beyond becoming gradualy subequal; club 4-jointed, the joints two and a half times as long as thick. The cup of the scutellum is small, high, and narrowed, with a central fovea, the sides closely punctate. Wings hyaline, pubescent, with long marginal ciliæ, the venation brown; the marginal cell is closed, triangular, slightly longer than wide, the first and second abscissas of the radius straight and about of an equal length. Abdomen very

slightly longer than the thorax, polished, with a pubescent girdle at the base.

Hab. St. Vincent.

Described from a single specimen.

PENTACRITA, *Förster.*

PENTACRITA OBSCURIPES, sp. n.

♀. Length 1 millim. Polished black; antennæ brown; legs reddish yellow, the middle and posterior coxæ black, their femora more or less dusky or black. Antennæ 13-jointed, the five terminal joints enlarged, moniliform, the last joint a little the longest; basal joint twice as long as the pedicel, which is rounded; the funicle-joints are more slender, submoniliform, the first about twice the length of the second, the joints beyond very gradually increasing in length and width to the club. The cup of the scutellum is very small, with a slight fovea posteriorly; anteriorly it is smooth, the sides rugose. Metathorax pubescent. Wings hyaline, fringed, the venation yellow; the marginal cell is about one half longer than its width, closed, the first abscissa straight and slightly shorter than second, which is slightly curved outwardly. Abdomen polished black, as long as the head and thorax together and with a pubescent girdle at base.

Hab. St. Vincent.

Described from a single specimen.

LEPTOPILINA, *Förster.*

LEPTOPILINA MINUTA, sp. n.

♀. Length $\frac{4}{5}$ millim. Polished black; antennæ brown; legs flavo-testaceous, the posterior femora brownish. Antennæ 13-jointed, about as long as the body, the seven terminal joints cylindrical, about thrice as long as thick, and thicker than the basal funicle-joints, which are slender; the first funicle-joint is about one third longer than the second; scape and pedicel swollen, the latter globose. Scutellum rather high, slightly projecting over the metathorax, which is short, and abruptly declining posteriorly; the cup is small, elliptic, its dorsum smooth, with a few round punctures. Metathorax short, with two delicate medial carinæ. Wings hyaline, strongly fringed, the apex with a slight sinus, the venation pale brownish yellow; the marginal cell is closed, about twice as long as wide, the second abscissa of

radius very slightly longer than the first. Abdomen not longer than the thorax, polished, with a very slight pubescent girdle at base.

Hab. St. Vincent.

Described from a single specimen.

Heptameris, *Förster*.

Heptameris rufipes, sp. n.

♀. Length 1½ millim. Polished black; antennæ brownish, the two basal joints black; legs reddish yellow. Antennæ 13-jointed, subclavate, the seven terminal joints thicker than the preceding, not fluted, the last joint the longest, one half longer than the preceding; the first funicle-joint is one half longer than the second, the second and third equal, the fourth as long as the first. Scutellum at sides finely rugose, its cup elliptic, and connected with the mesonotum by a delicate carina, its dorsum with a small fovea posteriorly and with some punctures anteriorly. Wings hyaline, sparsely pubescent, and with short ciliæ, the venation yellowish; the marginal cell is open along the outer margin, a little more than one and a half times as long as wide, the second abscissa of radius about one third longer than the first, both straight. Abdomen as long as the head and thorax together, black, polished, piceous beneath towards the base, and with a distinct woolly girdle.

Hab. St. Vincent.

Described from one specimen.

Heptameris flavipes, sp. n.

♀. Length 1¾ millim. Differs from *H. rufipes* in having black antennæ, except the three or four basal funicle joints, which are piceous, the 7 apical joints fluted; the first funicle-joint is only slightly longer than the second, the three following about equal; the cup of scutellum is small, elliptic, its dorsum smooth, not foveated: while the second abscissa of the radius is one and a half times as long as the second; the metapleura pubescent.

Hab. St. Vincent.

Described from two specimens.

Hypolethria, *Förster*.

Hypolethria longicornis, sp. n.

♀. Length 1⅘ millim. Polished black; the five basal joints

of the antennæ and the legs honey-yellow. Antennæ 13-jointed, longer than the body, all the flagellar joints long, cylindric, the 7 or 8 terminal joints slightly thickened and delicately fluted, averaging about thrice as long as thick; the first funicle-joint is about as long as, or very slightly shorter than, the second. Cup of scutellum large, broadly oval, nearly round, its dorsum excavated and with some punctures, the outer margin piceous. Abdomen as long as the thorax, polished black, with a woolly girdle at base; the hypopygium prominent, acute, ploughshare-shaped, piceous. Wings hyaline, pubescent, the marginal cell closed, about two and a half times as long as wide, the cubitus more or less distinct; the second abscissa of the radius is about one and a half times as long as the first, very slightly bent. One specimen has the apex of the wings slightly emarginate.

Hab. St. Vincent.

Described from three specimens.

HEXACOLA, *Förster*.

This genus is represented by three closely allied species, which may be separated as follows:—

Females.

Dorsum of cup smooth, polished, with a small fovea posteriorly and *two* punctures anteriorly; antennæ black.
- Posterior coxæ black, all femora dusky .... *H. solitaria.*

Dorsum of cup smooth, polished, with a small fovea posteriorly, and *four* punctures anteriorly; antennæ brown or fuscous.
- All coxæ and legs yellow or reddish yellow.
  - The five funicle-joints together not longer than the three basal joints of club, the four apical joints of the funicle not longer than wide.... *H. modesta.*
  - The five funicle-joints together much longer than the three basal joints of club, the four apical joints of funicle longer than wide........ *H. Sancti-Vincenti.*

Males.

First flagellar joint much longer than the second, clavate, slightly curved.
- Flagellar joints after the first thrice as long as thick; the dorsum of cup with two punctures. *H. solitaria.*

Flagellar joints after the first less than thrice as long as thick; the dorsum of cup with four punctures .... *H. Sancti-Vincenti.*

First flagellar joint not longer than the second.

Flagellar joints about twice as long as thick; the dorsum of cup with four punctures .... *H. modesta.*

HEXACOLA SOLITARIA, sp. n.

♂ ♀. Length 1 millim. Polished black; mandibles rufous; antennæ black, the funicle-joints piceous; legs reddish yellow, the posterior coxæ and all femora more or less black or dusky. Face with deep lateral clypeal sutures. Antennæ 13-jointed, not reaching to the middle of the abdomen, the six terminal joints enlarged; the five funicle-joints together are scarcely longer than the three basal joints of club, the first joint is almost twice as long as the second, the second and the following moniliform; the joints of the club, except the last, are scarcely longer than thick, delicately fluted and pubescent. Cup of scutellum small, elliptic, its dorsum smooth, polished, with a small fovea posteriorly and two punctures, its sides being finely longitudinally striated. Tegulæ black. Wings hyaline, strongly fringed, the venation yellowish; the marginal cell is about once and a half as long as wide, the outer margin open toward the apex, the second abscissa of radius very slightly longer than the first, straight, the second very slightly arched inwardly. Abdomen as long as the thorax, polished, with a distinct woolly girdle at base.

The antennæ in the male are 15-jointed, brown-black, the third joint being clavate, a little curved, and one third longer than the fourth, the joints beyond being about thrice as long as wide and all fluted; legs reddish yellow; tegulæ piceous. Otherwise in the scutellum, venation, &c. it is identical with the female.

Hab. St. Vincent.

Described from two specimens, a male and female.

HEXACOLA MODESTA, sp. n.

♂ ♀. Length $\frac{4}{5}$ to 1 millim. Polished black; mandibles yellowish; antennæ brown or piceous; legs honey-yellow or reddish yellow, the femora rarely infuscated. Antennæ 13-jointed, extending scarcely beyond the base of the abdomen, the six terminal joints enlarged, moniliform; the five funicle-joints together

are not longer than the three basal joints of the club, the first joint the longest, the four following small, moniliform, not longer than wide. Cup of scutellum small, elliptic, its dorsum polished, with a small fovea posteriorly and four punctures anteriorly, the sides aciculated. Tegulæ rufo-piceous. Wings hyaline, strongly fringed, the venation pale brownish; the marginal cell is about once and a half as long as wide, open along the outer margin, the second abscissa of the radius about one fourth longer than the first, both being straight. Abdomen as in previous species, a little piceous beneath.

In the male the antennæ are very long, brown or black, the third joint not longer than the fourth, the joints beyond about twice as long as thick, while the first abscissa of the radius is very slightly bent.

Hab. St. Vincent.

Described from two male and seven female specimens.

HEXACOLA SANCTI-VINCENTI, sp. n.

♂ ♀. Length 1 to $1\frac{1}{5}$ millim. Polished black; mandibles and palpi pale rufous; antennæ brown, more or less dusky toward the tips; legs yellow or reddish yellow. The antennæ are 13-jointed, extending fully to the middle of the abdomen, the six terminal joints moniliform, longer than thick; the five funicle-joints together are always much longer than the three basal joints of the club, the joints longer than wide, the first one being about twice as long as the second. Scutellum as in *H. modesta*. Tegulæ piceous. Wings hyaline, strongly ciliated, the venation yellowish; the marginal cell is less than twice as long as wide, open along the margin, the first and second branches of the radius about equal, slightly curved. Abdomen as in previous species.

In the male the antennæ are much longer than the body, brown, the third joint much longer than the fourth, slightly curved, clavate, the following joints about twice as long as thick; the legs yellow.

Hab. St. Vincent.

Described from many specimens.

RHOPTROMERIS, *Förster*.

RHOPTROMERIS INSULARIS, sp. n.

♀. Length $1\frac{3}{5}$ millim. Polished black; mandibles and palpi

yellowish; six basal joints of antennæ pale brown, the seven terminal joints black; legs yellow. Antennæ 13-jointed, the seven terminal joints enlarged, about one fourth longer than thick, fluted; the four funicle-joints are slender, the first the longest, the following subequal, longer than thick. Scutellum rugose at sides, the cup not large, elliptic, narrowed a little at base, the outer margin yellow, the disk excavated. Wings hyaline, ciliated, the venation pale; the marginal cell is less than once and a half as long as wide, open along the outer margin, the second abscissa of radius being but slightly longer than the first. Abdomen scarcely longer than the thorax, polished, with a woolly girdle at base.

Hab. St. Vincent.

Described from a single specimen.

EUCOILA, *Westw.*

Several distinct species in this genus are in the collection, and may be separated as follows:—

Moderate-sized species........ .... 2.
Large species.
  Abdomen and legs rufous.
    Dorsum of cup divided into two nearly equal parts by a transverse carina.
      Collar with a tuft of yellow hairs on each side, its projecting ridge deeply emarginated at the middle .... *E. basalis*, Cr.
2. Legs, including coxæ, yellowish or rufous.
  Sides of scutellum areolated, its cup small, much elevated posteriorly, and produced into a long carina anteriorly; metathorax more or less rufous, pubescent, its neck rugose .... *E. claripennis.*
  Sides of scutellum finely rugose, its cup rather large, broadly oval, without a carina anteriorly, its dorsum smooth, with a transverse fovea behind, and about six punctures surrounding the margin anteriorly; metathorax black, almost bare, its neck striated .. *E. ovalis.*

EUCOILA BASALIS, *Cr. Proc. Ent. Soc. Phil.* iv. p. 5.

Hab. Cuba and St. Vincent.

A large series of this species was taken by Mr. Smith.

EUCOILA CLARIPENNIS, sp. n.

♀. Length $2\frac{1}{2}$ millim. Polished black; metathorax dull rufous; mandibles, antennæ, except toward tips, and the legs rufous. Antennæ 13-jointed, gradually incrassated toward tips, submoniliform, the four terminal joints black, the first flagellar joint a little longer than the second. Collar with a tuft of yellowish hairs at sides, the transverse ridge only slightly emarginated. Scutellum piceous, areolated at the sides, the cup very small, elevated posteriorly, and extending anteriorly into a carina. Metathorax carinated, pubescent. Wings hyaline, subpubescent, but with a short marginal fringe; the marginal cell is a little less than twice as long as wide, the second abscissa of the radius being once and a half as long as the first, the latter slightly curved. Abdomen as long as the head and thorax together, polished black, with a distinct woolly girdle at base.

Hab. St. Vincent.

Described from three specimens.

EUCOILA OVALIS, sp. n.

♀. Length 2 millim. Polished black; mandibles and legs reddish yellow; antennæ yellowish, the six apical joints fuscous. Antennæ 13-jointed, gradually incrassated toward tips, submoniliform; the first joint of funicle one third longer than the second, cylindric, the four following subequal, the six terminal joints fluted, about once and a half as long as thick, the last the largest. Collar with a few pale glittering hairs at the sides, the transverse ridge scarcely emarginated at the middle. Scutellum finely rugose at the sides, the cup rather large, broadly oval, with a pale rim, the dorsum smooth, with a small fovea posteriorly and about six submarginal punctures anteriorly. Metathorax short, nearly bare, carinated. Wings hyaline, pubescent, the venation yellow; the marginal cell is about once and a half as long as wide, the second abscissa being about one fourth longer than the first, straight; the first is very slightly curved. Abdomen as long as the head and thorax together, polished black, piceous along the venter, with a distinct woolly girdle at base.

Hab. St. Vincent.

Described from two specimens.

(?) EUCOILA CARINATA, *Cr. l. c.* p. 6.
Hab. Cuba.

ANECTOCLIS, *Förster*.

ANECTOCLIS sp.

♀. Length $2\frac{1}{5}$ millim. Polished black; mandibles black; antennæ piceous; legs reddish yellow. Antennæ 13-jointed, submoniliform, gradually incrassated toward tips, the first flagellar joint scarcely longer than the second. Transverse ridge of collar deeply emarginated at the middle. Scutellum rugose at sides, the cup elliptic, its margins pale, the dorsum with a fovea posteriorly and several punctures anteriorly. Metathorax short, pubescent, the metapleura with a pubescent ridge posteriorly. Wings hyaline, pubescent, the venation yellow; the marginal cell is about twice as long as wide, entirely open along its outer margin, the second abscissa of radius very slightly curved and almost twice as long as the first, which is straight. Abdomen as long as the head and thorax together, polished black, piceous beneath toward base, and with a woolly girdle at base.

Hab. St. Vincent.

Described from a single specimen.

HEXAPLASTA, *Förster*.

The genera *Hexacola* and *Hexaplasta*, Förster, are very similar, and are separated upon very slight characters; it is often a matter of guesswork to place the species, the slight difference in the cup of the scutellum, used by Förster, being probably not sufficient to separate them. Of the former he says:—"Schildchen an der Spitze zugerundet, scharf gestreift, der Napf nicht gross, elliptisch, mit einem Grübchen am Hinterrande;" of the latter:—"Schildchen kaum gestreift, Napf gross, flach, glatt und glänzend, hinter mit einem runden Grübchen;" so that virtually the only difference is in the size of the cup.

The following species, in having the cup large, agrees with this definition, and is described under this genus.

HEXAPLASTA INCERTA, sp. n.

♂ ♀. Length $1\frac{1}{5}$ to $1\frac{4}{5}$ millim. Polished black; mandibles and legs reddish yellow; antennæ variable from piceous to yellow, the terminal joints usually dusky or black. Antennæ

13-jointed, the six terminal joints enlarged; the first joint of funicle is a little longer than the second, the following all longer than thick. Transverse ridge of the collar truncate, scarcely emarginate at the middle. Scutellum rugose at the sides, the cup large, broadly oval, the rim pale, the dorsum smooth, polished, with a small fovea posteriorly and about six submarginal punctures anteriorly. Wings hyaline, fringed, the venation yellow; the marginal cell is usually closed, rarely slightly open along the margin towards the apex, and less than twice as long as wide; the first abscissa of the radius is a little shorter than the second and slightly arched. Abdomen as long as the head and thorax together, black, polished, with a hairy girdle at base.

The male has long, brown-black, 15-jointed antennæ, the three basal joints paler; the first flagellar joint is not longer than the second, the following about equal, thrice as long as thick, fluted, hairy.

Hab. St. Vincent.

Described from one male and twenty female specimens.

Subfamily Figitinæ.

Solenaspis, *Ashmead.*

Solenaspis bifoveolata, *Cr.*

Aspicera bifoveolata, *Cr. Proc. Ent. Soc. Phil.* iv. p. 7.

Hab. Cuba, St. Vincent.

Sixteen specimens of what is undoubtedly this species are in the collection.

Solenaspis rufipes, *Cr.*

Aspicera rufipes, *Cr. l. c.* p. 7.

Hab. Cuba.

Subfamily Cynipinæ.

Cynips, *Linn.*

Cynips (?) armatus, *Cr. Proc. Ent. Soc. Phil.* iv. p. 4.

Hab. Cuba.

Without doubt this species will prove to be one of the Figitids.

Report on the Chalcididæ *of the Subfamilies Chalcidinæ, Eucharinæ, Perilampinæ, Encyrtinæ, Aphelininæ, Pireninæ, Elasminæ, and Elachistinæ.* By L. O. Howard.

Subfamily Chalcidinæ.

Spilochalcis, *Thomson.*

Spilochalcis femoratus.

Crabro femoratus, *Fabr. Syst. Ent.* p. 375, no. 10 (1775).

Sphex punctata, *Fabr. Spec. Ins.* i. p. 446 (1781).

? Chalcis fasciata, *Oliv. Enc. Méth.* v. p. 439, no. 9 (1790).

Smicra subpunctata, *Walk. Ent. Mag.* ii. p. 25 (1834).

Smicra nigropicta, *Cress. Proc. Ent. Soc. Phil.* iv. p. 55 (1865).

Smicra dorsivittata, *Cameron, Biol. Cent.-Am., Hym.* i. p. 90, pl. v. fig. 2.

Smicra femorata (*Fabr.*), *Kirby, Linn. Journ., Zool.* xvii. p. 66.

This handsome species is represented in a series of 29 male and female specimens which show surprisingly little variation. I have seen a single specimen from Jamaica.

Spilochalcis fulvescens.

Smicra fulvescens, *Walker, Ent. Mag.* ii. p. 25.

Smicra fulvescens, *Walker, Cresson, Trans. Am. Ent. Soc.* iv. p. 56.

The 109 male and female specimens which the St. Vincent collection contains show an extraordinary variation in size, from 4 millim. to 12 millim. in length, but are otherwise constant.

Spilochalcis nigritus, sp. n.

Average length 3·3 millim.; expanse 5·6 millim. Hind femora with 17 teeth beneath; petiole of abdomen about one half the length of the hind coxa. General colour black, with rather close, short, whitish pubescence; mandibles yellow; a yellow spot at insertion of antennæ; margin of eyes behind narrowly yellow, and a short spot in middle of front eye-margin; two small contiguous yellow spots in middle of hind margin of pronotum and two still smaller on either side, one on hind margin and one a little before and mesiad of this; a small yellow spot a little before middle of each parapsidal furrow of mesoscutum; a larger roundish yellow spot on each side of mesoscutellum; an irregular transversely oval light lemon-yellow spot each side of dorsum of third abdominal segment (counting petiole as first); trochanters faintly yellowish at tips; all femoro-tibial knees yellow; all tibiæ yellow, with a black band in centre; all tarsi light yellow;

hind femora with a single small yellow spot above, and a larger one just at knee. Wings hyaline, veins dark brown, the white interruption at juncture of submarginal with marginal very distinct.

Described from twenty male and female specimens from St. Vincent. Comes nearest to *S. torvina* (Cresson).

SPILOCHALCIS MISTURATUS, sp. n.

Length 2·5 millim.; expanse 3·7 millim. Hind femora with 12 teeth below; petiole of abdomen one half as long as hind coxa, spur at base below long and slender; terebra exserted, one third as long as abdomen. Antennæ yellow, brownish at tip; head yellow, occiput dark brown, face with two faint brownish longitudinal stripes, wider above than below; prothorax entirely yellow; mesoscutum brown, rather bronzy, with two broad yellow stripes down the mesial margin of the parapsidal sutures; mesoscutellum yellow, with a large central brown spot, scapulæ brown; metanotum and petiole yellow; meso- and metapleura and mesosternum dark brown, nearly black; abdomen light brown, darker at sutures, with a complete yellow band on anterior border of third segment; pygidium black at tip; all legs light yellow, hind coxæ with a black spot above at base, and hind femora with a brownish shade on outer basal half and another at curve of tip; teeth of hind femora black. Wings hyaline, veins dark brown.

Described from three female specimens. St. Vincent.

CHALCIS, *Fabricius*.

CHALCIS ANNULATUS.

Chalcis annulatus, *Fabricius, Ent. Syst.* ii. pp. 197–9; *Systema Piezatorum*, p. 167.

Length variable, the largest specimens measuring 6 millim., and the smallest 3 millim.; expanse of largest specimens from 9 to 10 millim. Cheeks very delicately punctured; genal sulcus sharp and deep; clypeus with a few sparse round punctures, and with a double impressed line just below its juncture with the epicranium; above this line is a single transverse row of round punctures; vertex and dorsum of thorax closely and rather coarsely punctate, the punctation of metanotum being almost reticulate from its coarseness; abdomen smooth; all body except

first abdominal segment with short yellowish pile, which is very abundant at tip of mesoscutellum; on second abdominal segment this pile is present only in two dorso-lateral patches, but in following segments there is a deep fringe from the border of each; hind femora with 11 teeth below, first and eleventh largest, the others well separated, except 8, 9, and 10, which are shorter and close together. Colour black; tegulæ, with the exception of three minute black spots, bright yellow; apical third of front and middle femora bright yellow, the line of juncture between the black and the yellow on the outer surface oblique: front and middle tibiæ yellow except a black patch on the outer middle; all tarsi yellow; hind femora with a single rather large yellow patch at upper tip extending into the black of the outer surface for a little over one fourth the length of the femur; hind tibiæ black at base and with a sharp black band a little beyond middle, being thus divided approximately into alternate black and yellow fourths; wings hyaline, veins dark brown except basal half of submarginal vein of hind wings, which is bright yellow.

Eighteen male and female specimens from different parts of the island of St. Vincent.

ANTROCEPHALUS, *Kirby*.

ANTROCEPHALUS PUNCTIGERUS.

Chalcis punctigera, *Fabr. Syst. Piez.* p. 167, no. 31. South America.

There is some doubt both as to the generic and specific placing of this form, which is represented in the St. Vincent collection by 29 males and 35 females. It corresponds closely with the very brief diagnosis of the genus given by Kirby (Linn. Soc. Journ., Zool. xvii. p. 63), but this description is incomplete, and the types, *Halticella fascicornis*, Walk., and *H. diversicornis*, Walk., belong to the South Asiatic fauna. It is plainly distinct, however, from any other Chalcidine genus, as defined by Kirby. It is the female antenna which is figured and described by Kirby. That of the male differs considerably. It is apparently only 11-jointed, since but one dividing suture in the club can be seen. The scape is much shorter, being less than one fifth the length of flagellum, and reaches only to middle of eyes. The pedicel is very short, about as broad as neck of scape, and about as long as broad. Joint 1 of funicle is suddenly broader, nearly twice as

broad as pedicel and twice as long as broad. The other funicle-joints are stout, cylindrical, and all of the same diameter; joint 1 is longest, and the rest diminish gradually in length to 7. The club is rounded at tip, and is slightly longer than joint 7 of funicle. The generic description states that the hind femora are unarmed, but the figure (pl. iv. fig. 25) shows a series of short, close, and extremely minute teeth or bristles, 20 in number, on the outer half of the lower border. This is substantially the case with the St. Vincent specimens. The projections are exceedingly minute teeth about 35 in number.

Fabricius's *Chalcis punctigera* has not, I believe, been redescribed; hence we may safely apply the name to this form, since the few words of description fit sufficiently well.

♀. Length 3·3 millim.; expanse 5·8 millim. Head and thorax with rather close, large, roundish punctures, and with sparse light yellow pile; segments 3, 4, 5, and 6, and pygidium of abdomen with close white pile; pygidium with a slight central longitudinal dorsal carina; metascutellum with two median longitudinal parallel carinæ; attached to each of these at top and bottom is an outwardly curved bow-shaped carina; rest of metanotum reticulate; fimbria sparse, silvery white; basal constricted half of first abdominal segment longitudinally striate, with a more marked central longitudinal carina. Colour black; pedicel and funicle-joints 1–4 of antenna dark honey-yellow; tegulæ brown; all trochanters and tarsi honey-yellow; base and tip of fore tibiæ, all of middle femora and tibiæ, except median dark band on each and extreme tips of hind tibiæ, honey-yellow. Wing-veins dark brown, nearly black; fore wings with two irregular transverse fuscous patches, the proximal one much darker and arising from the costal border coincident with the marginal vein, broadening slightly and becoming lighter towards anal margin and interrupted below middle by a hyaline streak (the spurious cubital nervure); the distal one arises from costal margin halfway between stigma and apex, gradually widens, and merges proximally with proximal band costad of the cubital hyaline streak which forms the anal limit of this outer band.

♂. Length and expanse slightly less on the average. Striation of base of abdomen more pronounced, forming five well-marked longitudinal carinæ united at anterior ends; antennæ

entirely black; middle femora and tibiæ honey-yellow only at tips; infuscation of wing lighter.

NOTASPIS, *Walker*.

NOTASPIS FORMICIFORMIS.

Notaspis formiciformis, *Walker, Ent. Mag.* ii. p. 37. St. Vincent.

One of the most peculiar Chalcidids known. Represented by 18 specimens, one of which is labelled: "Open swampy land near sea, south end of Island: beaten from bushes, Sept. 27."

PODAGRION, *Spinola*.

PODAGRION BRASILIENSIS, sp. n.

♀. Length of body 2 millim.; ovipositor 1·6 millim.; expanse 3·7 millim.; greatest width of fore wing 0·58 millim. Head and face regularly and not coarsely shagreened; pro- and mesonotum finely and closely punctate, and furnished with a few short, sparse, white, scale-like hairs; metanotum not carinate, finely and closely granulate; abdomen smooth, shining, with a few similar white hairs, which are also present on head, pleura, and coxæ; ovipositor about as long as entire body; antennæ regularly clavate, funicle-joint 1 shorter than pedicel, 2–7 gradually increasing in width; club regularly ovate when seen from side, rather acute at tip, as long as preceding five funicle-joints together; (in one specimen the club is indented exteriorly from drying). General colour greenish black, slightly metallic; antennal scape, pedicel, and funicle-joints 3, 4, 5, 6, and base of 7 bright honey-yellow; funicle-joints 1 and 2, apical two-thirds of 7, and all of club black or dark brown; mandibles dark brown; distal one-third of fore coxæ, all of middle coxæ, tip of hind coxæ, all of fore and middle femora, tibiæ and tarsi, base and extreme tip of hind femora, tip of hind tibiæ, and all of hind tarsi honey-yellow, the colour quite uniform, the fore femora alone somewhat darker.

Described from two female specimens from St. Vincent. The specific name is derived from the fact that Mr. H. H. Smith has also collected the form in Brazil, several specimens occurring in a collection now in the hands of Mr. Ashmead.

Subfamily Eucharinæ.

Kapala, *Cameron*.

Kapala furcata.

Eucharis furcata, *Fabr. Syst. Piez.* p. 158.

Eucharis flabellata, *Fabr. l. c.*; *Walker, Entomologist*, i. pl. P. fig. 2.

Chirocerus furcatus, *Brullé, Nat. Hist. des Ins., Hym.* iv. p. 571, t. 38. fig. 5.

Thoracantha furcata, *Hal. Entomologist*, i. pl. P. fig. 2.

Kapala furcata, *Cameron, Biol. Centr.-Am., Hym.* i. pl. v. fig. 17. Costa Rica, Guatemala, Panama, South America.

One male and three females of this species were taken by Mr. Smith. One of the females has an ant clasped in her jaws. This is, perhaps, significant in view of the supposed parasitism upon ants of members of this group.

Orasema, *Cameron*.

Orasema stramineipes.

Orasema stramineipes, *Cameron, Biol. Centr.-Am., Hym.* i. p. 105, pl. v. fig. 20.

Three specimens, 1 male and 2 female, from St. Vincent.

Orasema minutissima, sp. n.

♀. Length 1·1 millim.; expanse 2·8 millim.; greatest width of fore wing 0·46 millim. Front and vertex delicately rugulose; face finely shagreened, with a curved suture each side of facial impression; mesonotum rather strongly but finely granulate; metanotum smooth, with a median longitudinal carina and a lateral somewhat oblique suture. General colour dark metallic greenish blue; scape of antennæ light straw-yellow, flagellum dusky; middle coxæ metallic, fore and hind coxæ fuscous; fore femora light brown, middle and hind femora and all tibiæ and tarsi light straw-yellow; wing-veins very light, tegulæ yellowish.

♂. Dimensions about the same, the long petiole compensating for the shorter abdomen. Face more closely shagreened, curved sutures nearly obsolete; mesonotum more strongly granulate; metanotum delicately shagreened, central carina very faint. Flagellum of antenna darker than in female; all legs stramineous except coxæ, which are metallic at base and yellowish at tip.

Described from 17 females, 5 males. St. Vincent.

CHALCURA, *Kirby*.

CHALCURA AMERICANA, sp. n.

♀. Length 2·4 millim.; expanse 5·2 millim. Face nearly smooth below and at margins of eyes, with very faint interrupted striæ and very sparse punctures; several rather strong longitudinal grooves begin at insertion of antennæ and extend parallel with antennal groove nearly to occipital margin; disk of mesoscutum coarsely reticulate, the cells irregularly pentagonal or hexagonal, lengthening out obliquely on the parapsidal sutures, and becoming longitudinally greatly lengthened on the mesoscutellum, axillæ, pleura, and metanotum; petiole finely longitudinally aciculate; abdomen smooth, shining. General colour shining black; all legs except coxæ nearly white, faintly yellowish, almost translucent; coxæ brown; antennal scape, pedicel, and the plainly 3-jointed club bright honey-yellow; the six funicle-joints brown, joints 5 and 6 somewhat lighter than the first four. Wings hyaline; fore wings absolutely devoid of marginal cilia; wing-veins faintly coloured except stigma, which is brown; fore wing below stigma with a faint, irregularly rounded, infuscated patch.

Described from one female specimen. St. Vincent.

Subfamily PERILAMPINÆ.

PERILAMPUS, *Latr*.

PERILAMPUS POLITIFRONS, sp. n.

♂. Length 1·7 millim.; expanse 3 millim. Face smooth, shining; margin of antennal groove rounded, no carina; facial grooves below insertion of antennæ well marked; transverse furrow between the facial grooves also pronounced; vertex slightly and sparsely punctate; occiput very plainly transversely striate, the striations parallel with the curve of the occipital margin; antennæ short, clavate, slightly hairy; dorsum of thorax coarsely, thickly, but shallowly punctate, but one row of these punctures showing in middle of pronotum, each depression with a slight central elevation, from which arises a short white hair; axillæ delicately longitudinally striate; outer border of parapsidal suture smooth; tip of mesoscutum not indented; metascutellum with a well-marked median longitudinal carina; nucha plainly transversely striate; all pleura smooth; head and thorax with

sparse, short, white pubescence; all femora and tibiæ somewhat pubescent; abdomen smooth, shining. General colour black; antennal flagellum light brown; trochantero-femoral and femoro-tibial articulations honey-yellow; front and middle tibiæ honey-yellow at either extremity; hind femora entirely honey-yellow; all tarsi whitish; submarginal vein pale to the point where upward bend begins, thence brown; other veins of fore wing brown; wing-membrane perfectly hyaline.

Described from two male specimens, St. Vincent. Differs from other described species principally in the caputal characters.

Subfamily ENCYRTINÆ.

CERCHYSIUS, *Westw.*

Syn. Aseirba, *Cameron.*

This genus, erected by Westwood in 1832 ('London and Edinburgh Philosophical Magazine and Journal of Science,' vol. i. July–December, 1832, p. 127) with very brief characters, for *Encyrtus urocerus*, Dalm., is rejected by Mayr, who retains *urocerus* in the genus *Encyrtus.* Thomson retains *Cerchysius* with a somewhat indefinite diagnosis; and as two species are found in the St. Vincent material which possess in part the characters of *C. urocerus*, it is deemed best to use the generic name *Cerchysius*, especially as the terebral characters alone separate the forms from all other members of the true genus *Encyrtus*. The characters which may be regarded as of generic value and in which the following species agree are as follows:—

♀. Head subsemiglobose; eyes widely separated; ocelli forming a right-angled triangle; antennæ inserted below middle of face, scape somewhat widened below and reaching to vertex; flagellum long, slender, and cylindrical, club very slightly enlarged. Mesoscutum and scutellum somewhat flattened, together somewhat tectiform, the scuto-scutellar furrow forming the ridge; scapulæ meeting at apex. Abdomen triangular; terebra exserted for at least half the length of abdomen proper. Legs rather longer than normal, resembling in this respect those of *Leptomastix*; middle tibial spur not quite so long as first tarsal joint. Wings with short marginal, postmarginal, and stigmal veins, the latter subequal in length; a narrow, oblique, hairless streak extending from costal margin at stigmal vein to near base of wing on anal margin.

♂. Differs from female mainly in the funicle-joints of the

antennæ, which are plano-convex dorsally and slightly concave ventrally, subequal in length, each about three times as long as broad, and each furnished with two whorls of long hair. The spur of middle tibia rather longer than the corresponding first tarsal joint.

Cameron's genus *Aseirba*, placed by this author in the *Eupelminæ* (Biol. Centrali-Americana, Hymenopt., i. p. 127, pl. vi. fig. 13), seems, both from description and figure, to be a synonym of *Cerchysius*.

CERCHYSIUS TEREBRATUS, sp. n.

♀. Length (to tip of terebra) 2 millim.; expanse 2·7 millim. Antennal scape nearly cylindrical, only very slightly widened below. Head and mesoscutum glistening, very finely shagreened, with sparse larger punctures and short sparse pubescence; mesoscutellum deeply and closely, though finely shagreened, opaque; pleura and abdomen smooth, glistening; terebra a little over half the length of the abdomen, pubescent, especially toward tip. General colour honey-yellow, legs somewhat lighter than body; mandibles brown; antennal scape black at base and with a dark longitudinal dorsal streak; pedicel dark at base and with apical half light honey-yellow; all funicle-joints dark brown, except joint 2, which is light honey-yellow, with the exception of a brownish apex, club light honey-yellow; head sometimes slightly infuscated; sides of metascutellum and base of abdomen fuscous; terebral sheaths black except at base; pygidium dusky at tip; wing-veins dark.

♂. Length 1·1 millim.; expanse 2·7 millim. Antennal scape entirely black; mesoscutellum with a central dusky patch; metascutum dusky; metascutellum honey-yellow; dorsal surface of abdomen infuscated. Otherwise agrees with female.

Described from two females and one male.

CERCHYSIUS PULCHRICORNIS, sp. n.

♀. Length (to tip of terebra) 2 millim.; expanse 3·3 millim. Scape considerably widened. Head and mesonotum opaque, densely and finely punctate, and clothed (particularly mesoscutum) with rather close appressed pubescence. General colour rather bright honey-yellow; antennæ black, variegated with silvery white as follows: a narrow band near base of scape, a broader band at tip, apical half of pedicel, all of funicle-joints 2

and 6 and the club; terebral sheaths and tip of pygidium below black, as in *C. terebratus*.

Described from one female specimen.

ÆNASIUS, *Walker*.

This genus, proposed by Walker in 1846 for his *Encyrtus hyettus*, has never been sufficiently described, and is not recorded in any of the nomenclators. I have little or no doubt, however, of the identity of a peculiar form contained in the collection with *E. hyettus*, and have therefore drawn up the following full generic description:—

♀. Resembles in general appearance the female of *Bothriothorax*. Antennæ strongly clavate; scape rather short, reaching only to middle of eye, with a very broad, leaf-like, inferior expansion; pedicel, funicle, and club together forming a regular ovate, clavate mass, slightly flattened towards tip and rapidly widening from the very narrow base of the pedicel to the articulation of the first and second joints of the club, thence gradually rounding off; each of the six funicle-joints much wider than long: club nearly as long as entire funicle. Antennal grooves deep, converging; eyes very large, hairy, mainly lateral; genal sulcus distinct, complete; front rather narrow above, widening rapidly below; ocelli forming a nearly equilateral triangle, lateral ocelli touching border of eyes; entire head except occiput and facial depression covered closely with large thimble-like depressions, each with a very minute central piliferous tubercle; occipital ridge very acute. Pronotum not visible in the specimen at hand; mesoscutum short; mesoscutellum large, long, acutely margined, rounded posteriorly, having a fine, sharp, longitudinal groove for about one fifth its length at base; scapular sutures absent, represented only by very faint depressed lines, visible only in a strong light, but which can then be traced with difficulty and indicate that the scapulæ are well separated at tips. Abdomen short, triangular; terebra not extruded. Submarginal vein of fore wings short; marginal very short, almost wanting; stigmal rather long, slender, very slightly curved, extending down at an angle of about 40 degrees with the postmarginal, club very small; postmarginal somewhat longer than stigmal. Legs of the normal Encyrtine type, rather short; front tarsi especially short.

♂. Differs from female in following particulars:—Antennæ more hairy and not so strongly clavate; pedicel plainly distinct

from funicle, and joints of funicle are well separated, giving a serrate appearance to the margin; first funicle-joint very narrow; joint 2 suddenly wider; widest point of flagellum at about joint 5 of funicle; club short, not longer than the three preceding funicle-joints together, obliquely truncate at tip, appearing acute from side and rounded from above. Vertex broader than in female. Pronotum narrow, entire. (This is probably also the case with the female, in which it cannot be seen.) Abdomen very short, not longer than mesoscutellum in specimens at hand, in which, however, it is doubtless abnormally short through drying.

Ænasius hyettus.

Encyrtus hyettus, *Walker, Ann. Mag. Nat. Hist.* xvii. (1846) p. 181. St. Vincent.

♀. Length 1·6 millim.; expanse 3·9 millim.; width of body at tegulæ ·07 millim. Antennal scape closely pubescent above, but not on leaf-like expansion; front also pubescent. Head with large thimble-like punctures; mesonotum very faintly shagreened, nearly smooth; abdomen smooth, shining; colour uniform black, with bluish metallic reflections on dorsum of thorax; all tarsi honey-yellow, final joint black; middle tibial spur dark brown, nearly black; fore wings dark fuscous, veins nearly black; hind margin also black; hind wings hyaline, veins dark brown.

♂. Length varying from 0·88 millim. to 1·26 millim.; expanse varying from 2 millim. to 2·9 millim. Closely resembles the female except in the distinctions pointed out in generic diagnosis, but the metallic reflections are not so strong, and the fore wings are only faintly suffused with fuscous, while the veins are brown.

Redescribed from one female and four male specimens; one labelled "May," another "South end," and the rest with the customary label.

Habrolepoidea, gen. nov.

♀. Antennæ 11-jointed; scape moderately long, with a slight leaf-like expansion below; pedicel stout, nearly as broad as long; the 6-jointed funicle short, compressed, all joints broader than long, increasing slightly in width from 1 to 6, and also slightly in length, joint 6 being longest; club flattened, oval, widest at tip of first joint, considerably wider than sixth funicle-joint and as long as entire funicle. Head flattened above, long

between the sharp occipital ridge and the rounded frontal ridge, appearing triangular from side, the frontal ridge forming the vertex of an obtuse-angled triangle, of which the facial side is a trifle longer than the vertical, while the occipital side is much the longest and is slightly convex; eyes large and almost entirely lateral, the ocellar space broad, and the ocelli at the angle of a slightly obtuse-angled triangle; genal sulcus distinct but not complete, reaching neither border of eye nor border of mouth. Pronotum very short, completely hidden by occipital margin of head in the only specimen at hand. Scapulæ just meeting at tip; mesoscutellum triangular, acute at tip, with two depressions each side near tip, which may possibly be the result of shrivelling. Abdomen subtriangular, flattened, terebra just visible. Marginal vein of fore wings present, but shorter than stigmal; postmarginal present, nearly as long as stigmal; stigmal rather long, straight, slightly curved at tip, and forming a very acute angle with the postmarginal.

HABROLEPOIDEA GLAUCA, sp. n.

♀. Length 0·93 millim.; expanse 2·2 millim.; greatest width of fore wing 0·35 millim. Head smooth, shining, with a very faint striation and a few faint and very sparse fine punctures, a row of small punctures at border of eyes. Mesonotum lustrous, very faintly and finely reticulate. General colour dark brown, black, or metallic; head with steel-blue reflections, mesonotum with golden-green reflections; abdomen black; antennæ honey-yellow, darker at articulations; all legs honey-yellow, coxæ black. Wings hyaline.

Described from one female specimen.

HOMALOPODA, gen. nov.

♀. Antennæ 9-jointed; scape reaching to vertex, cylindrical, slender; pedicel slender, subcylindrical, nearly twice as long as broad; the funicle-joints slender, cylindrical, subequal in length, each longer than pedicel; club as long as the three preceding funicle-joints together, very elongate-ovate, slightly wider than funicle or somewhat flattened, in which case it is considerably wider. Head with long flattened face and deep antennal grooves converging towards vertex; genal sulcus distinct, from eye to mouth; vertex and dorsal surface of eyes flat, making the head appear triangular from the side; eyes rather

close, not large and mainly dorsal, ocelli forming an acute-angled triangle; occipital ridge rounded. Pronotum sharply incised in middle; scapulæ narrow towards tips, barely meeting; mesoscutellum declivous, subtriangular, rather rounded at tip, and having a sparse tuft of bristles; metascutum very short. Fore and middle legs normal, rather short; hind femora somewhat enlarged, convex on the outer surface, plane on the inner; hind tibiæ flattened laterally. Wings fuscous, with oblique hairless line below stigma and with several hyaline spots; submarginal vein short, reaching margin before one half the wing-length; marginal short, obscured by brown bristles, but longer than the short stigmal, which obliques into the wing-surface at an acute angle with the post-costa; postmarginal wanting. Abdomen as long as thorax, concave above, subtriangular, although somewhat rounded towards apex; terebra exserted to about one sixth the length of the abdomen.

This genus is one of the intermediate forms between the *Encyrtinæ* and the *Eupelminæ*, and presents in fact quite as many Eupelmine as Encyrtine characters.

HOMALOPODA CRISTATA, sp. n.

♀. Length varying from 1·11 millim. to 1·86 millim.; expanse varying from 2·26 millim. to 2·79 millim. Face lustrous, very faintly shagreened; vertex deeply, closely, and finely shagreened; mesoscutum as with face; mesoscutellum as with vertex; abdomen smooth, shining. From the occipital ridge near the eyes arise two slender blunt modified hairs or scales, plainly flattened antero-posteriorly, and which may resemble the "schmale . . . . abgerundete Lamellen," which occupy a similar position in the European *Habrolepis Dalmanni*, Westw. Mesoscutellum with a sparse tuft of bristles near tip. Wings fuscous, hyaline at base and with six hyaline spots, three on either border of the wing, and all touching wing-border except the proximal caudal one, which is separated from border by a continuation of the fuscous; the two distal ones crescent-shaped and the others roundish, the proximal one on the costal margin considerably smaller than the others and situated halfway between beginning of fuscous shading and stigmal vein; middle costal hyaline spot beginning just at stigmal vein, the middle caudal spot being just opposite on caudal wing-border; marginal vein with many dark bristles, making a distinct brown patch at that point. General colour

metallic greenish blue; dorsal surface of head golden-green; mesoscutellum copper-coloured; antennæ very dark brown, scape slightly metallic; all legs black or slightly metallic, middle and hind tarsi dirty white with terminal joint brown, fore tarsi light brown.

Described from four female specimens, two labelled "Leeward side." One of these specimens lacks the apical pair of hyaline spots on the wing, but should not be separated.

COMYS, *Förster*.

COMYS BICOLOR.

Comys bicolor, *Howard, Report of the Entomologist, Annual Report Department of Agriculture*, 1880, p. 362.

Parasitic on the cosmopolitan *Lecanium hesperidum* and other congeneric species in the United States.

Two female specimens, St. Vincent.

LEPTOMASTIX, *Förster*.

LEPTOMASTIX DACTYLOPII.

Leptomastix dactylopii, *Howard, Bulletin 5, Division of Entomology, U.S. Department of Agriculture* (*Washington*, 1885), pp. 23, 24.

District of Columbia. One male, St. Vincent.

COPIDOSOMA, *Ratzeburg*.

COPIDOSOMA DIVERSICORNIS, sp. n.

♀. Length 1·4 millim.; expanse 2·6 millim.; greatest width of fore wing 0·37 millim. Antennal club flattened dorso-ventrally, rather longer than funicle-joints 5 and 6 together, and but slightly wider than joint 6, slightly rounded at apex; first funicle-joint nearly twice as long as pedicel; joint 2 of funicle slightly longer than pedicel; joints 2, 3, 4, 5, and 6 subequal in length and width. Punctation of head and thorax as usual. Marginal vein of fore wings as long as stigmal. Ovipositor not extruded. Colour black, without metallic reflections; antennal scape brown, with a whitish band at tip; pedicel, joints 1, 3, 4, 5, and 6 of funicle, and base of club black; joint 2 of funicle and rest of club silvery-white; tegulæ honey-yellow at tips, otherwise black; all coxæ black; fore and middle femora black at base, honey-yellow beyond; hind femora black nearly to the honey-yellow tip; all tibiæ and tarsi very light honey-yellow, the underside of the middle tarsi appearing brownish from the numerous brown spines.

Described from two male specimens (216 and 207).

ENCYRTUS, *Dalm.*

Table of Species.

All funicle-joints of antennæ wider than long	*E. crassus*, sp. n.
All funicle-joints not wider than long.	
Club very broad, at least three times as wide as preceding funicle-joint	*E. argentipes*, sp. n.
Club not especially broad, but slightly broader than preceding funicle-joint.	
Head and mesoscutum very hairy..........	*E. hirtus*, sp. n.
Not especially hairy.	
Antennæ uniformly honey-yellow.	
Wings partly infuscated..............	*E. nitidus*, sp. n.
Wings hyaline......................	*E. quadricolor*, sp. n.
Antennæ black, yellow at tip	*E. flaviclavus*, sp. n.
Antennæ brown	*E. tiliaris*, Dalm.

ENCYRTUS CRASSUS, sp. n.

♀. Length 1·37 millim.; expanse 2·8 millim. Belongs to the same group as *E. inquisitor*, How. (Ann. Rept. Dept. Agr. 1880, p. 67, pl. xxiv. fig. 1), and the European *E. clavellatus*, Dalm. Body short and stout. Antennæ with the scape slightly widened beneath; joints 1–6 of the funicle gradually increasing in width, all wider than long; pedicel $2\frac{1}{2}$ times longer than first funicle-joint and somewhat wider; club broad, flattened, subcircular, as long as three preceding funicle-joints together. Front wide, ocelli forming an obtuse-angled triangle. Head and mesonotum delicately shagreened. Marginal vein of fore wings absent. General colour black, moderately lustrous, without metallic reflections; antennal club with whitish pile at tip; front and hind tarsi brown; middle tarsi and middle tibial spur light honey-yellow, with claws only dark. Wings hyaline, veins brown; a trace of a radial vein extends from tip of stigmal club in a curved direction, reaching costal margin at a point nearly halfway from stigmal club to tip of wing.

Described from one female specimen.

ENCYRTUS QUADRICOLOR, sp. n.

♂. Length 1·16 millim.; expanse 2·67 millim. Antennæ inserted halfway between middle of face and mouth; scape subcylindrical, not broadened, not long; pedicel twice as long as broad; all six funicle-joints of equal length with pedicel, but increasing slightly in width from 1 to 6; club a little longer than the two preceding funicle-joints together, oval, slightly flattened,

broader than joint 6; flagellum with very short pubescence. Front very convex, almost angulate in middle; facial depression very marked; genal sulcus complete, but very indistinct; eyes sparsely hairy; vertex not narrow, ocelli forming a slightly obtuse-angled triangle; head with a very fine reticulated sculpture and with a single row of fine punctures around the margin of the eyes; occipital ridge extremely sharp. Mesoscutum very finely but closely and deeply shagreened and furnished with fine sparse pubescence, opaque; mesoscutellum highly lustrous, nearly smooth, slightly shagreened near base. Marginal, postmarginal, and stigmal veins of the fore wings all nearly equal in length. General colour bright honey-yellow; antennæ brown, darkest on upper surface of scape, pedicel, and club; head and pronotum uniform black, with greenish-metallic lustre; mesoscutum, except lateral margins, a brilliant peacock-blue; mesoscutellum golden-green; abdomen dark, with a golden-green lustre; hind tarsi dusky, nearly black.

Described from one male specimen.

ENCYRTUS NITIDUS, sp. n.

♀. Length 1·4 millim.; expanse 2·6 millim. Resembles *E. fuscipennis*, Dalm., perhaps more closely than any other species. Scape arising halfway between bend of face and mouth, subcylindrical, not broadened, very short, only five times as long as thick; pedicel three times as long as thick and twice as long as the somewhat narrower first funicle-joint; funicle-joints increasing very slightly in length and more in width from 1 to 6; club flattened, oval, as long as the two preceding funicle-joints together. Front narrow between the eyes; ocelli forming an acute-angled triangle; front and vertex very finely shagreened, with four rows of punctures; cheeks smooth; genal sulcus absent. Mesoscutum lustrous, very faintly shagreened, with sparse, short, whitish pubescence; mesoscutellum densely punctulate at base, then closely striate to tip, which is smooth and shining. Abdomen flattened dorso-ventrally, acuminate, as long as head and thorax together; ovipositor slightly extruded. Stigmal vein given off at juncture of submarginal and costa, short, postmarginal of equal length; a broad, oblique, hairless line below stigma, across which passes obliquely towards costa a single row of minute hairs. General colour black, with metallic-greenish or bluish reflections; antennæ honey-yellow, flagellum a little darker than scape; front legs, including coxæ, light honey-yellow;

middle coxæ metallic, yellowish at tip; femora, tibiæ, tibial spur, and tarsi honey-yellow, femora brownish at middle; hind coxæ honey-yellow, slightly darker at base, tibiæ and tarsi honey-yellow, femora dark except at tips. Wings hyaline; fore wings with a dusky patch of an irregular trapezoidal form, beginning in the middle opposite stigma and extending to tip, gradually widening, occupying at widest portion of the wing about one-third of the wing-width.

Described from five female specimens.

ENCYRTUS ARGENTIPES, sp. n.

♀. Length 0·7 millim.; expanse 1·6 millim. Agrees in some structural details with *E. brevicornis*, Dalm., but differs in having the antennal scape but slightly broadened, in the shape of the head, and in coloration. The sole specimen is badly mounted and this description is necessarily incomplete. Antennæ inserted a little below middle of face; scape short, very slightly widened below in middle, pedicel very short; funicle conical, short, not longer than club, the joints widening rapidly; club as long as funicle, obliquely flattened, nearly circular. Facial impression horseshoe-shaped, the central ridge rounded but pronounced; vertex flattened, narrow, the ocelli forming an acute-angled triangle, the head appearing rather triangular from side, somewhat as in *Habrolepis*. Marginal vein of fore wings short, postmarginal present, as long as stigmal, the latter forming a narrow angle with the postmarginal. Head faintly shagreened; mesonotum appearing smooth and glistening (the sculpturing, if any, obscured by mounting medium). Colour shining black; antennal scape silvery-white at tip, funicle silvery-white, with dense short white pubescence, club black; all coxæ black; all femora, tibiæ, and tarsi silvery-white, the femora with a black band at middle and the tibiæ with a black band between middle and proximal end. Wings hyaline.

Described from one female specimen. This species probably belongs to a new genus; but, without specimens from which all the characters can be studied, it seems inadvisable to establish one.

ENCYRTUS HIRTUS, sp. n.

♀. Length 0·9 millim.; expanse 2 millim.; greatest width of fore wing 0·36 millim. Forms a new type in the genus, and will doubtless eventually be separated generically. Antennal scape short, stout, not widened below; pedicel very narrow at proximal end, two and one half times longer than its width at distal end;

first funicle-joint one half as long as pedicel and nearly as broad as long; joints 2 to 6 subequal in length, but increasing somewhat in width, joint 6 being once and half broader than long; club as long as three preceding funicle-joints together, oval, its sutures distinct and its first joint slightly broader than joint 6 of funicle, making the whole flagellum slightly clavate. Head somewhat triangular when seen from side, the facial angle below the middle; face and vertex hairy, delicately shagreened, with a few sparse larger punctures; eyes hairy. Mesoscutum finely granulate, well covered with short black hairs; mesoscutellum smooth, shining, almost hairless; abdomen short, smooth, circular in outline; legs short and stout; marginal, stigmal, and postmarginal veins of fore wings subequal in length. Colour: head and thorax to scuto-scutellar furrow of mesonotum dull dark metallic green; mesoscutellum and abdomen bright metallic green, with golden reflections; all legs and antennæ honey-yellow.

♂. Rather smaller than female, with which it almost exactly agrees. Antennæ with funicle-joints subequal in length, well separated, and each with a double whorl of long hairs. Abdomen subtriangular.

Described from two females and one male.

ENCYRTUS FLAVICLAVUS, sp. n.

♀. Length 1·1 millim.; expanse 2·7 millim. Antennal scape moderately long, slender, not widened; pedicel short, its breadth at tip equalling its length; funicle and club somewhat flattened laterally; joints 1, 2, 3, 4, and 5 of funicle subequal in length and width, each longer than broad and a little longer than pedicel; joint 6 shorter; club oval, as long as funicle-joints 5 and 6 together; face and vertex smooth, with a few sparse punctures; mesoscutum delicately transversely shagreened; mesoscutellum with aciculate longitudinal punctation; abdomen cordate, shorter than thorax; marginal and postmarginal veins of fore wing each slightly longer than stigmal, the latter forming a very slight angle with postmarginal. Colour: head and pleura metallic purple; rest of body metallic green, mesoscutellum with a coppery lustre; antennal scape honey-yellow; funicle and base of club very dark brown; rest of club bright orange-yellow; all legs honey-yellow.

Described from one female specimen. St. Vincent.

ENCYRTUS TILIARIS.

Encyrtus tiliaris, *Dalm. Vet. Ac. H.* 1820, p. 174 (47); *Nees, Hym. Ichn. aff. Monogr.* 1834, p. 235; *Mayr, Die Eur. Encyrtiden, Verh. d. zool.-bot. Ges. Wien*, 1875, p. 722.

Encyrtus coniferæ, *Walk. Ent. Mag.* iv. 1837, p. 461.

Encyrtus cupratus, *Först*; ? *Mayr, loc. cit.*

Two females and one male of what seems to be this European species. St. Vincent.

Subfamily APHELININÆ.

COCCOPHAGUS, *Westwood*.

COCCOPHAGUS LECANII.

Platygaster Lecanii, *Fitch, Fifth Report on the Insects of New York*, p. 25.

Coccophagus Lecanii, *E. A. Smith, 'American Naturalist,'* 1878, p. 661; *Seventh Report, State Entomologist of Illinois* (1878), p. 130.

Coccophagus Lecanii (*Fitch*), *Howard, Report of Entomologist, Annual Report U.S. Department Agriculture*, 1880, pp. 357, 358.

Two female specimens. St. Vincent.

In the United States this insect is parasitic upon *Lecanium quercitronis*, Fitch (N. Y.), *Pulvinaria innumerabilis*, Rathvon (Ills. and D. C.), and *Lecanium hesperidum*, Linn. (D. C. and Cal.). The last-named is a cosmopolitan species and undoubtedly occurs on the island of St. Vincent, since it has been found on Jamaica and Montserrat.

ENCARSIA, *Förster*.

ENCARSIA FLAVICLAVA, sp. n.

♀. Length 1 millim.; expanse 1·8 millim. Antennal flagellum slightly clavate when seen from side; funicle-joints subequal in length and increasing slightly in breadth from 1 to 4, joint 4 nearly as broad as long; club oval; seen from above, the funicle is parallel-sided and the club is much narrower through lateral flattening; terebra exserted for one-third length of abdomen; abdomen with parallel sides to an abruptly conical tip. General colour honey-yellow; scape of antennæ darker, pedicel and funicle black, club light yellow; lateral borders of abdomen brown; a dark brown, nearly black, patch at lateral anal angles of abdomen; venter of abdomen with brownish shades; wings hyaline, veins light.

Described from one female specimen. St. Vincent.

Subfamily Pireninæ.

Herbertia *, gen. nov.

♀. Antennæ 10-jointed, inserted just above clypeus, short, clavate; scape short, slender, not reaching to middle of face; funicle-joints subequal in length, but increasing rapidly in width from 1 to 5; club short, compact, acute at tip, flattened from side; face below eyes short, genæ straight; facial depression deep and broad, occupying more than half the width of face between eyes, its margin rounded; eyes hairy; ocelli large, placed at the angles of a right-angled triangle; occipital margin rounded. Parapsidal furrows of mesoscutum sharp and complete, continuous with axillar furrows; axillæ widely separated; mesoscutum and scutellum rather flat, in the same longitudinal plane, scutellum at tip and metanotum abruptly declivous; submarginal vein of fore wing reaching costa at about one third the wing-length, marginal a little longer than submarginal; postmarginal long, shading off almost imperceptibly, apparently somewhat more than one third the length of marginal; stigmal short, very oblique, about one third the length of postmarginal, club not pronounced, uncus rather long, forming a little more than a right angle with a shaft of stigmal; metanotum nearly rectangular, a little narrower behind, the hinder angles sharp and a little extended; hind coxa with a pronounced dorsal tooth above near tip as in some *Chalcidinæ*. Abdomen ovate, thick dorsoventrally; second tergite occupying about half of the dorsum of abdomen; pygidium rather large, projecting well beyond the terminal ventral segments (urites); ovipositor generally extruded.

♂. Very similar to female. Antennal flagellum shorter than in female, club equally flattened, but broader and rounded at tip; coxal projection less pronounced; metanotum more contracted behind. Abdomen ovate, slightly truncate at tip, not flattened, second tergite occupying less than half the dorsum.

Of the described Pirenine genera, this resembles most closely *Henicetrus*, Thomson, which I know, however, from the very brief description in 'Skandinaviens Hymenoptera,' iv. p. 190.

Herbertia lucens, sp. n.

♀. Length 1·5 millim.; expanse 2·5 millim. Antennal scape straight, slender, cylindrical; pedicel twice as long as first funicle-

* From Herbert, the first name of Mr. H. H. Smith.

joint, but slenderer; entire head, pro- and mesonotum closely shagreened; metanotum smooth, central carina well marked, alæ marked by evident carinæ; second tergite of abdomen perfectly smooth, glistening, other tergites dull, very faintly transversely striate. General colour metallic green, with bright golden reflections where punctation is lacking, as on mesopleura and second tergite; scape and pedicel of antennæ metallic, funicle and club dull brown with very short close pubescence; tegulæ dark brown; all coxæ and femora metallic; all tibiæ and tarsi yellowish white; abdomen beyond second segment dull purplish black, ovipositor light brown; wings hyaline, veins brown. Head, pronotum, mesonotum, and abdomen beyond second segment with short whitish pubescence.

♂. Resembles female, except that flagellum and club of antennæ are nearly black and the veins of fore wing are dark brown.

Described from nine female and five male specimens. St. Vincent.

EROTOLEPSIA, gen. nov.

♀. Antennæ 11-jointed (club 3, funicle 6, pedicel and scape), inserted at clypeal margin; scape long, slender, reaching nearly to anterior ocellus; flagellum somewhat longer than scape, subclavate; pedicel long, obconical, straight, as long as first three funicle-joints; first funicle-joint as broad as long, others subequal in length and increasing very gradually in width; club bluntly pointed; facial depression deep, its border sharp and slightly elevated; eyes naked; ocelli of moderate size, at angles of an obtuse-angled triangle, the lateral ones tangent to the occipital margin, which is slightly rounded. Parapsidal sutures indicated only at anterior margin of mesoscutum; mesoscutum rather flat; mesoscutellum slightly elevated, not abruptly declivous; submarginal vein of fore wing reaching costa at nearly one half the wing-length, marginal two-thirds as long as submarginal; postmarginal and stigmal subequal in length, the latter a trifle the longer, about one fourth as long as marginal; stigmal curved, club very slight, uncus very short; metanotum rounded, not carinate, but bears at the middle of its anterior border a stout, sharp, spine-like process, alæ separated by delicate sutures; hind coxæ not toothed. Abdomen ovate, very acute at tip, flattened above, well rounded beneath; second tergite excavated anteriorly and occupying nearly the whole dorsum of abdomen; pygidium as in *Herbertia*; ovipositor not exserted.

♂. Greatly resembles female; pedicel of antennæ not quite so long in proportion to the funicle-joints which follow; spine-like process of metanotum represented by a slight elevation only; club of stigmal vein of fore wings more pronounced than in female; abdomen bluntly rounded at tip; genital organs, when exserted, fully two thirds the length of abdomen.

The habitus of this genus is much like that of the preceding, in spite of the marked differences in structural detail. The head in all of the 18 specimens of both genera is thrown forward, the labium brought close to the fore coxæ, the occiput entirely exposed, and the rather prominent and well-rounded pronotum brought strongly into view.

EROTOLEPSIA COMPACTA, sp. n.

♀. Length 1·8 millim.; expanse 3 millim. Head, pronotum, and mesonotum finely shagreened, mesonotum with a few sparse round punctures, slightly glistening; pleura smooth, except mesepimeron and propleuron, which are faintly granulate; metascutellum very finely granulate; abdomen nearly smooth, shining; the long second abdominal tergite with two subparallel laterodorsal furrows extending from the cephalic nearly to the caudal end of the segment; between these furrows the cephalic end of the tergite is delicately longitudinally striate, the striations arising from the upturned cephalic border and fading away gradually about the middle of the segment, the lateral ones being a little longer than the central ones; ventral surface of abdomen delicately longitudinally striate, except at lateral border; head, mesonotum, and tip of abdomen with sparse whitish pubescence, of which there is also quite a pronounced fringe on outer border of hind coxæ; metanotal fimbria well marked. General colour dull black; antennal scape and pedicel honey-yellow, the pedicel shaded with brown above at base; all legs, except coxæ, uniform honey-yellow, tip of hind femora a little darker; fore wings slightly infuscated, the infuscation deeper in middle, veins dark brown.

♂. Somewhat smaller than female, which it resembles, however, in all other respects except usual sexual differences and those pointed out in generic diagnosis.

Described from two female and two male specimens. St. Vincent.

Subfamily Elasminæ.

Elasmus, *Westw.*

Table of Species.

Head smooth, with very small sparse punctures ..	*E. levifrons*, sp. n.
Head with irregular depressions	*E. rugosus*, sp. n.
Head with sparse large punctures..............	*E. punctatulus*, sp. n.
Head with close large thimble-like punctures.	
Head yellow, with round metallic frontal spot centred by anterior ocellus	*E. maculatus*, sp. n.
Head all yellow	*E. flavus*, sp. n.
Head metallic.	
Body nearly all yellow	*E. helvus*, sp. n.
Abdomen only yellow.....................	*E. flaviventris*, sp. n.
Body metallic.	
Hind coxæ with apical half yellow	*E. Smithii*, sp. n.
Hind coxæ all metallic	*E. punctatus*, sp. n.

Elasmus levifrons, sp. n.

♀. Length 2·2 millim.; expanse 3·4 millim.; greatest width of fore wing 0·39 millim. Face and vertex smooth, well rounded, with small sparse round punctures; pronotum and mesoscutum regularly scaly with appressed hairs; mesoscutellum very finely granulate, but shining; abdomen very faintly transversely striate, longer than head and thorax together; all pleura and hind coxæ hairless, shining, irregularly shagreened, the coxæ more coarsely than the pleura; middle and hind femora somewhat obliquely longitudinally shagreened, middle femora with sparse appressed hairs. Funicle-joints 1, 2, 3 of the antennæ subequal in length and width, all wider and longer than pedicel, but somewhat shorter than club, which is slightly flattened and acuminate; first tarsal joint of fore legs about half as long as tibia; corresponding joint of middle and hind legs as long as tibia. Two dark brown subparallel longitudinal raised lines on dorsum of fore and middle tibiæ; a series of five or six irregular longitudinal closed cells formed by similar dark brown lines on hind tibiæ*; middle tibial spur about $\frac{1}{4}$ as long as first tarsal joint. General colour dark metallic greenish-blue; antennæ dark brown, scape yellowish beneath; minute tip of scutellum yellowish white;

* These dark brown or black raised lines, the peculiar arrangement of which on the hind tibiæ affords such a good character in this genus, are, when examined under a high power, seen to be rows of acute appressed spines situated so closely together that their bases touch.

tegulæ yellowish white; distal half of fore coxæ and tip of middle coxæ, all trochanters, all of fore femora, except brown shade on proximal dorsal half, tips of middle and hind femora, all tibiæ and tarsi dirty white or yellowish white; bristles of all tibiæ and tarsi dark brown. Wings hyaline; veins light brown, faint; cilia of disk of wing very delicate; stigmal represented by a mere point.

♂. Length 1·2 millim.; expanse 2·6 millim.; greatest width of fore wing 0·35 millim. Differs only in the ordinary sexual differences of the genus; antennal branches subequal in length and reaching to middle of antennal club; the long hairs on branches dirty white.

Described from twelve female and eight male specimens.

ELASMUS RUGOSUS, sp. n.

♀. The single specimen of this species in the collection lacks antennæ and abdomen, but seems from general appearance to be a female. Its length can only be surmised, but the insect is apparently similar to the preceding in size. Expanse 2·6 millim.; greatest width of fore wing 0·34 millim. Differs from *E. levifrons* as follows:—Face and vertex closely covered with large irregular punctures; mesoscutellum smooth. No scutellar spot; the raised dark brown lines on dorsum of hind tibiæ forming much longer closed cells than in *E. levifrons*, the two largest occupying almost its entire length, the proximal of the two being considerably longer than the distal one; fore legs entirely dirty yellowish white; middle femora brown, whitish at tips; basal half of hind femora whitish, apical half brown; distal tip of hind coxæ whitish; wing-veins dark brown, stigmal not distinct, discal cilia closer and larger; disk slightly infuscated.

Described from one female (?) specimen.

ELASMUS PUNCTATULUS, sp. n.

♂. Length 1·2 millim.; expanse 3·1 millim.; greatest width of fore wing 0·39 millim. Differs from *E. levifrons* as follows:—Face and vertex with rather sparse round punctures, twice as large as in *E. levifrons*, and yet each with a definite smooth expanse about it. Scutellar spot orange-yellow, thin, crescent-shaped, with a plain triangular membranous transparent appendix or postscutellum; the raised dark brown lines on dorsum of hind tibiæ forming two subequal cells in the middle with a half cell at either end. Antennal scape entirely dirty white; clypeal margin of face yellowish; all fore legs, except base of coxæ,

yellowish white; middle and hind femora with merely a median band of slightly metallic dark brown.

Described from one male specimen.

Elasmus maculatus, sp. n.

♀. Length 2·2 millim.; expanse 3·7 millim.; greatest width of fore wing 0·44 millim. Face and head with close, deep, rather large round punctures, almost thimble-like; first tarsal joint of fore legs one third as long as tibia; middle tibial spur half as long as first tarsal joint; dark brown lines on dorsum of hind tibiæ forming no closed cells, but a continuous series of loops resembling three antique figures 5 superimposed. General colour dark metallic greenish-blue; antennæ light brown, scape entirely yellow; head and face yellow, except a large round spot of which the anterior ocellus is practically the centre and which reaches over the vertex and nearly to the eyes on either side; yellow scutellar spot large, together with the postscutellum nearly equalling the dark portion of the scutellum in length; tegulæ light brown; sides and venter of abdomen reddish yellow, except at base and tip; all legs, including front and middle coxæ, yellowish white with a translucent effect; lower half of hind coxæ concolorous with femora, upper half metallic; wing-veins dark brown. In other respects resembles *E. levifrons.*

Described from seven female specimens.

Elasmus helvus, sp. n.

♀. Length 1·6 millim.; expanse 3·4 millim.; greatest width of fore wing 0·39 millim. Face and vertex punctured as in *E. maculatus*; first tarsal joint one fourth as long as tibia; dark brown lines on hind tibiæ as in *E. rugosus*; middle tibial spur about one third as long as first tarsal joint. General colour honey-yellow; all of head, pronotum, lateral angles of mesoscutum, scuto-scutellar furrow of mesonotum, upper half of hind coxæ, and last two joints of abdomen metallic blue-green; middle and hind femora edged above by a narrow black line; antennæ brownish above, yellow below. Wing-veins dark brown, disk of fore wings slightly infuscated; stigmal vein very plain, straight, and not knobbed, running obliquely into the disk for a distance equal to about one sixth the width of the wing at that point; a delicate circular fuscous patch just below stigma. In other respects resembles *E. levifrons.*

Described from one female specimen.

ELASMUS FLAVUS, sp. n.

♂. Length 1·5 millim.; expanse 2·7 millim.; greatest width of fore wing 0·34 millim. Resembles *E. helvus*, except in the following respects:—middle tibia one third longer than first tarsal joint, its spur one half as long as first tarsal joint; hind tibiæ one third longer than first tarsal joint, the dark lines on dorsal surface forming two very narrow apposite closed longitudinal cells, each extending the entire length of the tibia. Head yellow, mesoscutellum (except bright yellow apex) metallic; metanotum and irregular patches on sides of third and fourth abdominal joints also metallic; hind coxæ with a narrow rim only of the metallic colour. Wing-veins plain, stigmal normal.

Described from one male.

ELASMUS FLAVIVENTRIS, sp. n.

♀. Length 1·95 millim.; expanse 3·6 millim.; greatest width of fore wing 0·44 millim. Most resembles *E. rugosus*, from which it differs as follows:—Face and vertex punctured as in *E. maculatus*; scutellar spot very small; first tarsal joint of middle and hind legs shorter than tibia; middle tibial spur rather more than one third as long as corresponding first tarsal joint; hind coxæ whitish, except just at base; tip of hind femora whitish; distal half of hind coxæ whitish; abdomen reddish yellow, except the two metallic apical joints and a small brown spot each side on the plane dorsum of segments 3 and 4. Stigmal vein of fore wings plain, slightly longer than usual and slightly curved towards apex of wing.

♂. Length 1·5 millim.; expanse 3·6 millim.; greatest width of fore wing 0·44 millim. Antenna proper exceptionally slender; scutellar spot absent, postscutellum alone showing a slight yellow spot; middle femora metallic only on upper and lower edge, disk yellowish.

Described from four females and one male.

ELASMUS SMITHII, sp. n.

♀. Length 1·8 millim.; expanse 3·4 millim.; greatest width of fore wing 0·39 millim. Differs from *E. levifrons* as follows:—Face and vertex punctured as in *E. maculatus*; abdomen shorter than head and thorax together; first tarsal joint of middle and hind legs slightly shorter than its tibia; middle tibial spur about one third as long as first tarsal joint; dark lines of hind tibia forming four closed cells, one long and one short covering the

length of the sclerite, and two short ones to the outside; post-scutellum only yellow; tegulæ metallic at base; all legs yellowish, except metallic base of hind coxæ; first and last two joints of abdomen metallic, the others reddish yellow; wing-veins dark, stigmal very distinct.

♂. Length 1·5 millim.; expanse 3·1 millim.; greatest width of fore wing 0·37 millim. Differs from female, beyond the ordinary sexual characters, only in having second joint of abdomen reddish yellow, and all coxæ and femora metallic, except at tips.

Described from two females and three males. The males may not belong to this species, and indeed in some respects resemble more the following species—*E. punctatus*—than the females with which I have associated them. The balance of characters, however, places them here rather than with any of the other species in the St. Vincent collection.

Elasmus punctatus, sp. n.

♀. Length 2·2 millim.; expanse 3·4 millim.; greatest width of fore wing 4·9 millim. Differs from *E. levifrons* as follows:—Head and face punctured as in *E. maculatus*; middle tibial spur more than one third as long as first tarsal joint; dark lines on hind tibia forming two narrow, wavy, longitudinal cells, side by side, and each extending the whole length of the sclerite, just as in *E. flavus*. Head, entire trunk, and all coxæ and femora uniform dark metallic greenish-blue. Wing-veins dark, disk very slightly infuscated. In two of the five specimens the front femora are reddish at apical third, and the abdomen is reddish brown ventrally at base.

Described from five females.

Subfamily Elachistinæ.

Euplectrus, *Westwood.*

Euplectrus furnius.

Euplectrus furnius, *Walker, Ann. Mag. Nat. Hist.* xii. p. 48 (=bicolor, *Swed.*). St. Vincent.

Represented by three males and one female.

Walker suspected the identity of this species with *E. bicolor* (Swederus)=*Elachistus albiventris*, Spinola,=*Euplectrus maculiventris*, Westwood; but a careful comparison of Thomson's description of *E. bicolor* with Walker's of *E. furnius* indicates that they differ in mesonotal characters.

Miotropis, *Thomson*.

Miotropis nigricans, sp. n.

♀. Length 1·5 millim.; expanse 2·4 millim. Head closely shagreened; eyes hairy; pronotum and mesonotum closely and finely punctate; the mesopostscutellum very finely rugose; metanotum smooth, its central longitudinal carina dividing anteriorly as well as posteriorly, the triangle formed by the anterior division wider than the nucha enclosed by posterior division, and with a slight spine-like elevation of the carina at point of division; hind coxæ faintly striate; petiole rugose; first abdominal tergite smooth, glistening; other tergites very faintly reticulate. Colour black; faint bluish reflections on head, pro- and mesonotum; antennæ and legs fuscous, tibiæ becoming ferruginous; all coxæ black; wings hyaline, veins brown.

♂. A single male, possibly of this species, but which is in such condition as to preclude careful study, seems to differ only in having the base of the abdomen yellowish above and below, fore and hind femora black except at distal end, and all tibiæ and middle femora very light yellowish white.

Described from two females and one male (?). St. Vincent.

Miotropis versicolor, sp. n.

♂. Length 1·4 millim.; expanse 2·4 millim. Smooth, shining; mesoscutum very faintly aciculate; eyes faintly hairy; median longitudinal carina faint, not dividing or projecting anteriorly, nucha broader than in *M. nigricans*. General colour bright honey-yellow, head lighter than thorax, approaching lemon-yellow; antennæ fuscous, with rather long lighter-coloured hairs; mandibles brown; occiput black; pronotum, except posterior lateral angles, black; mesoscutum, except parapsides, black; metascutellum with a broad, somewhat crescent-shaped black band, following its anterior margin; abdomen black, except at base and tip, the black portion above including a large oval yellowish spot; all tarsi fuscous; wings hyaline, veins fuscous.

Described from one male. St. Vincent.

Stenomesius, *Westwood*.

Stenomesius platynotæ.

Miotropis platynotæ, *Howard, Report on Insects affecting the Orange, by H. G. Hubbard, Washington, Dept. Agriculture*, 1885, p. 217. Florida.

One male and one female in the St. Vincent collection are

referable to this species with some slight doubt, since faulty mounting obscures some of the characters. The types were reared in Florida from the larvæ of *Platynota rostrana*, Walker.

ELACHISTUS, *Spinola*.

ELACHISTUS CAUDATUS, sp. n.

♀. Length 1 millim.; expanse 2 millim. Front very deeply impressed; eyes naked; mesoscutum very deeply and coarsely pitted; mesoscutellum smooth; metanotum with undivided median longitudinal carina, which is not specially elevated in front; lower border of front and hind femora with a fringe of rather long delicate hairs; ovipositor extruded to a distance which is nearly as long as entire abdomen; abdomen flattened, oval, rather strongly incised behind, flattened above. Colour black, shining; face honey-yellow, occiput with black centre and yellowish border to eyes; all coxæ honey-yellow; other joints of legs light yellow-brown. Abdomen piceous; wings hyaline, veins translucent, colourless.

Described from one female specimen. St. Vincent.

This will evidently form a new genus. I know of no other species in the subfamily Elachistinæ which has a similar ovipositor, and there are probably other distinguishing characters. The single specimen at hand, however, lacks antennæ, and is otherwise in poor condition for generic description.

ELACHISTUS SCUTELLATUS, sp. n.

♀. Length 1·5 millim.; expanse 3 millim. Facial depression broad, reaching nearly to margin of eyes, sharply defined just below insertion of antennæ by an acute transverse ridge; eyes hairy; ocelli forming slightly curved line; head and face slightly rugose; head with sparse long hairs; pronotum and mesoscutum slightly shagreened, with sparse large punctures; mesoscutellum with no indication of a median furrow, faintly longitudinally and quite regularly striate; median longitudinal carina of the metanotum broad, not high, not acute, divided into the two elements of the anterior transverse ridge; nucha narrow, surrounded by an elevated margin continuous with the median longitudinal carina; metanotal alæ separated by slight but distinct oblique furrows converging posteriorly; abdomen flattened, oval, not incised; mesonotal bristles long. Colour black, subopaque; abdomen with a basal honey-yellow spot above and below; antennal scape and pedicel and all legs, except hind coxæ

honey-yellow; wings hyaline; veins light brown, the stigmal club rather darker and bearing a pronounced uncus.

Described from two female specimens. St. Vincent.

ELACHISTUS AUREUS, sp. n.

♀. Length 1·8 millim.; expanse 3·4 millim. Facial depression similar to that of *E. scutellatus*, except that the transverse ridge below antennal insertion is lacking; sides of the depression smooth and shining; front and vertex faintly shagreened and with sparse round punctures; eyes sparsely hairy; mesoscutum rather coarsely granulate; mesoscutellum nearly smooth, very faintly reticulate; a shallow median longitudinal suture arises from the anterior border of this sclerite and ends beyond its middle; metanotum irregularly, coarsely, and deeply reticulate in centre; longitudinal carina faint; alæ smooth; nucha broader than in *E. scutellatus*; abdomen long, ovate, flat. Colour bright metallic green, with golden reflections; antennal scape and all legs yellowish white, somewhat translucent; hind coxæ darker near base; flagellum of antennæ brownish; base of abdomen metallic, segments 3 to 5 brownish; wings hyaline, veins nearly white; stigmal club not darker.

♂. The central brown patch of abdomen is narrower, and the middle and hind coxæ are metallic. The antennæ become darker toward tip, club being nearly black. Otherwise agrees with female.

Described from one male and two females. St. Vincent.

Report on the Parasitic Cynipidæ, *part of the* Braconidæ, *the* Ichneumonidæ, *the* Proctotrypidæ, *and part of the* Chalcididæ.—PART II. By WILLIAM H. ASHMEAD.

Family BRACONIDÆ.

Subfamily BRACONINÆ.

BRACON, *Fabr.*

Table of Species.

Wholly rufous or honey-yellow, except sometimes the head	3.
Not entirely black	2.
Entirely black.	
Plate of second abdominal segment not entirely separated from the surrounding surface. (Length $2\frac{1}{2}$ millim.). ♂	*B. niger.*

2. Head, thorax, and legs black.
 Abdomen rufous, the sutures deeply incised; wings black, the stigma yellow. ♂ ♀ .... *B. xanthospilus.*
 Abdomen piceous, the sutures not deeply incised; wings dusky, the stigma brown. ♀ ...... *B. niger.*
 Abdomen yellow, the sutures not deeply incised; wings fuliginous, the stigma brown-black; tarsi piceous. ♂ .... *B. seminiger.*

Head, pronotum, pectus, and legs black.
 Abdomen rufous; the sutures deeply incised; wings smoky, the stigma yellow. ♂ ♀ .... *B. flavomaculatus.*

3. Head above black or piceous.
 Thorax, anterior and middle coxæ and trochanters, the second joint of the posterior trochanters, posterior knees, and abdomen rufous. ♀ .. *B. maculiceps.*

Head not black.
 Rufous; wings black, with a streak in the first submarginal cell and a spot behind the recurrent nervure white. Legs black, all coxæ, middle femora beneath and the posterior femora rufous. ♂ ♀ .... *B. femoratus.*
 Honey-yellow or pale ferruginous.
  Wings subhyaline, iridescent; legs entirely pale; no plate or foveolæ on the second abdominal segment. ♂ ♀ .... *B. Sancti-Vincenti.*
  Wings smoky or blackish; tips of posterior tibiæ and tarsi black or fuscous; a plate and foveolæ on second abdominal segment. ♂ ♀ *B. vulgaris.*

Bracon niger, sp. n.

♂ ♀. Length $2\frac{1}{2}$ millim. to 3 millim; ovipositor longer than the abdomen. Black, shining, impunctured; the female abdomen piceous. Palpi yellow. Antennæ in female 33-jointed, in male 29-jointed. Thorax with a middle lobe prominently convex anteriorly, but without distinct furrows. Pleura and metathorax smooth, polished, the metapleura with a spiracular furrow. Wings dusky hyaline or blackish, the venation brown; the second abscissa of the radius is about two and a half times as long as the first; the second submarginal cell therefore very long, or as long as the third along its upper margin and a little longer along its lower margin; the recurrent nervure not interstitial, rejected, joining an angle in the first submarginal cell. Abdomen smooth, shining; the first segment is a little longer than the second, with side furrows that converge at base and

form a wedge-shaped shield; the second segment has two irregular grooved lines on each side of the middle that extend posteriorly about two-thirds the length of the segment; the suture between the second and third segments crenate; fourth segment with a transverse grooved line near the base.

Hab. St. Vincent.

Described from one male and one female specimen.

BRACON XANTHOSPILUS, sp. n.

♂ ♀. Length 7 to 8 millim.; ovipositor not quite half the length of the abdomen. Black, polished, covered with a sparse white pubescence; abdomen dark rufous, the two terminal segments black. Head subquadrate, narrowed behind the eyes. Palpi piceous. Antennæ longer than the body, black, multi-articulate, the joints after the third, to near the tips, not longer than wide. Thorax wholly smooth, shining, the metapleura separated from the dorsum of metathorax by a broad, smooth furrow, the spiracles round, situated just above the furrow at about its middle. Wings black, the stigma yellow; in the male the two basal cells are nearly hyaline, and nearly the whole of the first submarginal cell and a spot behind the recurrent nervure are white; the female also has a streak across the first submarginal cell and behind the recurrent nervure white, but not so large or distinct as in the male, while the basal cells are not hyaline. Abdomen ovate, the sutures deeply incised; the first segment has broad, crenate, lateral furrows with a subcordate shield; the second segment has a triangular shield at its basal middle, with broad oblique foveæ toward the sides; all the segments are smooth, shining, and impunctured.

Hab. St. Vincent.

Described from two male and two female specimens.

BRACON SEMINIGER, sp. n.

♂. Length 3 millim. Smooth, shining; head, thorax, and legs black; abdomen yellow. Head quadrate, not narrowed behind the eyes. Antennæ black, not quite as long as the body, all the joints being longer than wide. Wings fuliginous; the second abscissa of the radius is a little more than thrice as long as the first, the second submarginal cell therefore very long; the recurrent nervure is interstitial with the first transverse cubital nervure. Abdomen smooth, impunctured, linear, much

longer than the head and thorax together, the first segment the longest, with a triangular raised shield posteriorly, the second and following smooth, without shield; the sutures are not deeply incised.

Hab. St. Vincent.

Described from a single specimen, in poor condition.

BRACON FLAVOMACULATUS, sp. n.

♂ ♀. Length variable, from $3\frac{1}{2}$ millim. to 6 millim.; ovipositor about one third the length of abdomen. Rufous; head, antennæ, pronotum, pectus, and legs black; in the male the mesopleura are also black. The face, cheeks, pectus, and coxæ are covered with a whitish pubescence. Head subquadrate, narrowed behind the eyes. Metapleura separated from the dorsum of the metathorax by a furrow; the spiracles very minute, round, situated at about the middle of the suture. Abdomen ovate, the sutures deeply incised, the first segment longer than the second, with crenate furrows laterally forming a wedge-shaped shield; the second segment with a triangular-shaped shield at its basal middle, not entirely separated at its apex from the surrounding surface; on each side of this shield are deep oblique foveæ; the third segment has oblique grooved lines at its basal angles; the fourth segment with a transverse crenate furrow across the basal one-third. Wings black, the stigma yellow; the recurrent nervure is interstitial with the first transverse cubital nervure; the second abscissa of the radius is about four times the length of the first, the second submarginal cell therefore very long; the third submarginal cell is only a little longer than the second.

Hab. St. Vincent.

Described from one female and 17 male specimens.

BRACON MACULICEPS, sp. n.

♀. Length 3 millim.; ovipositor half the length of the abdomen. Rufous; head above, antennæ, wings, ovipositor, and legs (except anterior pair, middle coxæ, trochanters, tarsi, and second joint of posterior trochanters and posterior knees) black. Abdomen ovate, the sutures not deeply incised; the first segment with a wedge-shaped shield, the second with a triangular raised piece at the basal middle with a depression on each side of the piece. Wings dusky or black; the second abscissa of radius is

about two and a half times as long as the first, the recurrent nervure rejected.

Hab. St. Vincent.

Described from a single specimen.

BRACON FEMORATUS, sp. n.

♂ ♀. Length $2\frac{1}{2}$ to 8 millim.; ovipositor about half the length of abdomen. Rufous; antennæ, wings, and legs, with the exceptions herein afterwards mentioned, black; all coxæ, middle femora beneath, and the posterior femora rufous; in the male the anterior tarsi are pale. The whole surface, except the face, which is shagreened, is smooth and shining. Head transverse. Palpi in the female black, in the male white. Antennæ shorter than the body, the joints after the third transverse. Metapleura separated from the dorsum of metathorax by a furrow; the spiracles small, rounded. Abdomen ovate, the sutures not deeply incised; the shield of the first segment wedge-shaped, the second segment smooth, without a shield, and with but faint traces of the oblique furrows at the sides. The second abscissa of the radius is about four times as long as the first, the recurrent nervure rejected, while there is a white streak across the first submarginal cell and a white spot behind the recurrent nervure.

Hab. St. Vincent.

Described from 4 female and 12 male specimens.

BRACON SANCTI-VINCENTI, sp. n.

♂ ♀. Length $1\frac{1}{4}$ to 2 millim.; ovipositor short. Entirely honey-yellow or pale ferruginous; antennæ and eyes black or brown-black; wings greyish hyaline, iridescent, the nervures brown; the second abscissa of the radius is about two and a half times as long as the first, the recurrent nervure rejected. The whole surface is smooth, shining, impunctured. Abdomen ovate, the sutures not deeply incised; the first segment with a wedge-shaped shield, the following smooth.

Hab. St. Vincent.

Described from 24 individuals.

BRACON VULGARIS, sp. n.

♂ ♀. Length $2\frac{1}{2}$ to 4 millim.; ovipositor not quite as long as the abdomen. Honey-yellow or pale ferruginous; the antennæ black; wings fuliginous; tips of the posterior tibiæ and their tarsi fuscous or black. As in *B. Sancti-Vincenti*, its whole surface

is smooth, shining, impunctured, and the venation of the wings is identical. The second abdominal segment, however, has a subtriangular shield at its basal middle, which is not entirely separated at apex from the surrounding surface; there are also two shallow oblique lines on each side of the shield.

Hab. St. Vincent.

Described from many individuals of both sexes.

This species varies greatly in size, in the colour of the body, from a honey-yellow to pale rufous, and in the density of the colour of the wings.

MYOSOMA, *Brullé.*

MYOSOMA PILOSIPES, sp. n.

♂. Length 3 millim. Head above, antennæ, streak on pronotum, wings, tip of abdomen, and legs black; face, thorax, coxæ, and trochanters and abdomen rufous; the base of anterior tibiæ and tarsi and the base of middle tibiæ pale. The whole surface is smooth, shining, impunctured, sparsely hairy; the legs rather densely pilose. Antennæ about 36-jointed. Wings black; the second abscissa of the radius is about two and a half times as long as the first, or a little longer than the third; the second submarginal cell therefore long, as wide at apex as at base; the first transverse cubital nervure oblique, not interstitial with the recurrent nervure; the second transverse cubital nervure straight; the median and submedian cells are of an equal length; there is a hyaline or whitish streak across the base of the first submarginal cell that is extended into the third discoidal cell behind the recurrent nervure, while there is also a whitish streak in the second discoidal cell near the discoidal nervure. Abdomen ovate, the first segment the longest, with lateral furrows; the shield wedge-shaped, convex, smooth; second segment transverse, slightly longer than the third, with a fovea on each side of the basal middle, forming a small triangular shield that is not entirely separated behind, and on each side of these foveæ is another oblong foveola; the third segment has a curved impressed line at its basal middle that forms a small lunate or semicircular shield, and laterally with oblique grooved lines that extend into lateral foveolæ; while the fourth segment has two transverse impressed lines.

Hab. St. Vincent.

Described from two specimens. No species in this genus has yet been described from the North-American fauna, and the

present species is quite different from the three or four species known from South America.

MICROBRACON, *Ashmead*.

(Bull. no. 1, Col. Biol. Assoc. 1890, p. 15.)

MICROBRACON PILOSITHORAX, sp. n.

♂. Length 2 millim. Black, finely punctulate, but shining, and covered with sparse, glistening, white hairs; orbits, face, mandibles, palpi, legs, and most of the abdomen yellow; the shield of first and the dorsum of third and fourth abdominal segments brown. Antennæ 30-jointed, black. Mesopleuræ with a small fovea at the middle of its posterior margin. Metathorax finely shagreened, the metapleura bounded above by a delicate carina; the spiracles small, inconspicuous. Wings subhyaline, the first abscissa of the radius only a little shorter than the second, the third abscissa about twice the length of the second; the second transverse cubital nervure is short, the second submarginal cell, therefore, narrower at apex than at base, while the recurrent nervure is not longer than the second branch of the cubitus: in the hind wings the radial and cubital nervures are abbreviated and do not extend to the apical margin. Abdomen oval, shagreened, the second segment as long as the first, without shield, furrow, or foveola, the following segments subequal.

Hab. St. Vincent.

Described from a single specimen.

Subfamily SPATHIINÆ.

STENOPHASMUS, *Smith*.

STENOPHASMUS TERMINALIS, sp. n.

♂ ♀. Length 3 to 6 millim.; ovipositor longer than the body. Ferruginous, the abdominal segments usually more or less banded with dusky, especially toward apex, rarely entirely fuscous; sometimes the thorax more or less fuscous; the posterior legs usually with brownish or fuscous markings. Wings subfuscous, the venation brown. Head quadrate, smooth, except some transverse aciculations on the vertex. Ocelli contiguous, in a triangle. Antennæ longer than the body; in the female the four or five apical joints white; in male dusky or fuscous, the tips never white. Thorax trilobed, more or less transversely rugose; scutellum smooth on the disk; mesopleura with some longitudinal striæ superiorly; sternum sometimes black or fuscous, smooth;

metathorax rather long, with delicate lateral keels, and more or less lineately rugose. Abdomen longer than the head and thorax together; the petiole very long, as long as the posterior femora and trochanters together; the petiole, second segment, basal half of third, and the fourth segment opaquely shagreened; rest of the abdomen smooth, shining.

Hab. St. Vincent.

Described from 23 specimens. The species is exceedingly variable in size and somewhat in colour, but is readily distinguished from the other described species by the white tips of the female antennæ.

Subfamily HECABOLINÆ.

HETEROSPILUS, *Haliday.*

Table of Species.

Females.

Second abdominal segment with one or more transverse impressed lines or sutures.............. 2.

Second abdominal segment without a transverse impressed line or suture.

- Dark ferruginous; antennæ fuscous, the two basal joints and the sutures of all the joints, and the legs white or pale luteous, the legs with some brown markings; first and second abdominal segments and the basal half of the third striated. *H. ferruginus.*
- Black, opaque, minutely rugose; antennæ pale brown, yellowish basally; legs black; knees, tips of tibiæ, and tarsi honey-yellow; first abdominal segment and the basal half of the second opaquely sculptured .... *H. carbonarius.*

2. Second abdominal segment with one transverse suture .... 3.

Second abdominal segment with three transverse sutures longer than the first.

- Thorax and abdomen black or fuscous; head, collar, legs, band at base of second abdominal segment, and the apex of abdomen luteous or white; first abdominal segment and the second to the third transverse suture, and the basal portion of the third, striated or aciculated; the apex of the second segment and the rest of the abdomen smooth, polished .... *H. fasciatus.*

Second abdominal segment with two transverse sutures.

Pale ferruginous with fuscous markings; legs pale luteous.

First transverse suture of the second segment at the middle, the second at the apical one-third of the upper half; first segment and basal half of the second, and the bottom of the second suture striated or aciculated; the rest of the abdomen, except some faint aciculations at the bottom of a transverse suture on the third segment, smooth, polished; ovipositor as long as the abdomen .... *H. pallidipes.*

First transverse suture of the second segment curving inwardly at sides; the second suture straight, close to the apex of the segment; the third, fourth, and fifth segments with dark transverse bands; ovipositor much longer than the abdomen; first segment and the second, except the apex, striated .... *H. longicaudus.*

3. Second abdominal segment shorter than the first, or equal.................................. 4.

Second abdominal segment longer than the first.

Suture of second segment at about one-half the length of the segment, not arcuated.

Black, the head reddish, legs and two basal joints of antennæ white; third abdominal segment with a broad transverse suture before the middle, the basal portion very faintly and the broad suture distinctly aciculated, the apical portion and the following segments smooth, polished; ovipositor half the length of the abdomen.... *H. nigrescens.*

4. Suture of the second segment at about one-third the length of the segment, arcuated, in middle nearly obsolete.

Pale ferruginous, head, legs, and apex of abdomen luteous or white; first abdominal segment and the basal two-thirds of the second striated, the third showing some faint aciculations at base; the following segments rarely slightly punctate basally, usually smooth.......................... *H. quæstor*, Hal.

Variable, from ferruginous to luteous.

Mesopleura, sutures of thorax and metathorax above, and basal four abdominal segments dark fuscous or black; suture of second segment at about the middle, bending inwardly toward the sides; first segment and basal two-thirds of the second striated; the following two or three segments finely punctate at base, rest of the abdomen smooth .. *H. variegatus.*

Mesopleura, humeri, and base of metathorax more or less fuscous, rest of the insect, except legs, pale ferruginous; suture of second segment near the middle, subobsolete; first segment, basal two-thirds of second, and at the bottom of a depression near the base of third, striated or aciculated, rest of the abdomen smooth .... *H. humeralis.*

HETEROSPILUS FERRUGINUS, sp. n.

♀. Length $4\frac{1}{2}$ millim.; ovipositor 3 millim. Reddish brown, the thorax beneath and at sides blackish; antennæ brown, the incisions of joints whitish; legs whitish, all femora with a subapical reddish annulus, base and tips of tibiæ with reddish markings. Head quadrate, rugose, the vertex transversely aciculated. Antennæ 24-jointed, a little shorter than the body, the two basal joints white. Thorax rugose, the middle lobe of mesonotum prominent, reaching only to half the length of the mesonotum; disk of mesopleura smooth, polished; metathorax rugose, not areolated, and with only an abbreviated central keel at base. Wings fusco-hyaline, mottled toward tips with whitish spots or streaks. Abdomen much longer than the head and thorax together, the two basal segments and the basal half of the third opaque, finely striated; rest of the abdomen smooth, polished.

Hab. St. Vincent.

Described from a single specimen, taken in a forest at Morne à Garon, at an altitude of 1500 feet, under the bark of a stump, October 31.

HETEROSPILUS CARBONARIUS, sp. n.

♀. Length 2 millim.; ovipositor half the length of body. Black, opaque, finely, closely, confluently punctate, covered with a sparse white pubescence. Legs black or brown-black; the tibiæ at base, tips, and the tarsi honey-yellow. Head quadrate;

eyes large, subrotund, black. Antennæ 22-jointed, fuscous, the flagellum a little yellowish toward base. Thorax with the middle lobe prominent, rounded before, reaching only to half the length of the mesonotum; pleura closely punctate; metathorax not areolated, closely punctate, rugose toward tip. Wings hyaline, with a slight dusky streak in the region of the basal vein and below the stigma. Abdomen sessile, longer than the head and thorax together; the first and second segments about equal, quadrate, the first wholly and the basal half of the second lineately rugose; rest of the abdomen smooth, polished.

Hab. St. Vincent.

Described from a single specimen.

HETEROSPILUS FASCIATUS, sp. n.

♂ ♀. Length 2 to 5 millim.; ovipositor 4 millim. Head, collar, legs, broad band on second abdominal segment, and the apex of abdomen honey-yellow or luteous; rest of the insect, except the antennæ which are fuscous, black. Sometimes the anterior portion of the mesonotum and the pleura are pale, rarely with most of the thorax pale. Head quadrate, smooth; eyes large, rounded, very slightly sinuated within opposite the antennæ. Antennæ long, setaceous, from 30- to 34-jointed, the four or five basal joints pale. Thorax polished, with a few sparse hairs, the furrows large, distinct, converging and meeting at base of scutellum, the sides of the grooves margined within; collar distinct, narrowed before, rugose above; scutellum with two large foveæ at base, separated by a slight carina; mesopleura smooth, with an oblique fovea at the middle; metathorax rugose, areolated, the two long areas at base nearly smooth, a diamond-shaped area at the middle extending to the apex and connected with the base by a central carina, the surface of the area being rugose; metapleura rugose. Wings subhyaline, the stigma large, black or brown; the venation brown, the transverse vein between the first and second submarginal cells subobsolete or entirely wanting. Abdomen sessile, longer than the head and thorax together; the first segment longer than the second, narrowed toward base; the second segment quadrate, with three cross-lines or sutures, the first a little before the middle, the second at about one-third the length of the remaining portion, the third visible only at the sides and curving to the posterior angles of the segment; the third segment also has a cross-line or suture;

the first segment, basal two-thirds or more of the second, basal half of the third, and the fourth slightly at base longitudinally striated or aciculated; rest of the abdomen smooth, polished.

The male, which is very variable in size and colour, is usually pale or ferruginous, although sometimes presenting an exact colour-pattern of the female. Sometimes it is wholly pale, with only the metathorax, first abdominal segment, and two or three of the following segments dusky; the basal portion of the second segment, however, is always more or less distinctly yellow, and the sculpture is identical, or nearly so, in both sexes. The antennæ vary from 22- to 29-jointed.

Hab. St. Vincent.

Described from many specimens of both sexes.

HETEROSPILUS PALLIDIPES, sp. n.

♂ ♀. Length $1\frac{1}{2}$ to 3 millim.; ovipositor a little longer than the abdomen. Pale ferruginous; orbits, lower part of head, streak on collar, and legs white or luteous. Collar, humeri, mesopleura, and metathorax more or less fuscous. Head quadrate, smooth, except the vertex, which is transversely aciculated. Eyes very large, rounded, slightly sinuated within. Thorax finely shagreened, the furrows distinct, the middle lobe posteriorly in front of the scutellum with three or four raised lines; scutellum smooth, polished; metathorax areolated, rugose, the surface of the two large basal areas finely, closely punctate, the diamond-shaped area nearly obliterated by the rugosity of its surface. Wings subhyaline, the venation brown, the first and second transverse nervures subobsolete. Abdomen not longer than the head and thorax together; the second segment longer than the first, with two transverse impressed lines, the first at about half its length, the second at about one-third the length of the remaining half; the third segment also with a transverse, impressed line; the first segment and the basal half of the second longitudinally striated, the transverse impressed line on third aciculated at bottom; rest of the abdomen smooth, polished.

The male is uniformly pale ferruginous, and in sculpture agrees with the female.

Hab. St. Vincent.

Described from one male and two female specimens.

HETEROSPILUS LONGICAUDUS, sp. n.

♀. Length 4 millim.; ovipositor 3 millim. Pale ferruginous,

with fuscous tingeings in the sutures; antennæ dusky toward tips; legs honey-yellow. Head quadrate, smooth, the vertex transversely aciculated. Thorax shagreened, narrowed in front; the collar produced, striated at sides; parapsidal furrows distinct, the middle lobe rugose posteriorly; scutellum smooth, with a crenulated furrow across the base; pleura and metathorax rugose, the latter not areolated. Wings greyish-hyaline, strongly iridescent, the venation brown, the costa basally yellow, the transverse nervures of the second and third submarginal cells subobsolete. Abdomen longer than the head and thorax together, the base of third and fourth segments and the apex of the fifth and sixth embrowned; the second segment is longer than the first, with a transverse impressed line at about its middle that curves basally at the sides, and another straight subapical transverse line; first segment and the second, except near the apex, striated, the following segments, except the last two, microscopically punctate.

Hab. St. Vincent, leeward side.

Described from a single specimen.

HETEROSPILUS NIGRESCENS, sp. n.

♀. Length 2½ millim.; ovipositor shorter than the abdomen. Black; the head reddish brown, with transverse aciculations on the vertex; antennæ 24-jointed, brown, the two basal joints white. Thorax shagreened, opaque; scutellum smooth, shining, with a transverse crenulated furrow at base; pleura shagreened; metathorax rugose, areolated. Wings subfuscous. Abdomen as long as the head and thorax together, the second segment shorter than the first, with a depression at the middle; first segment and the second, except the apical one-third, striated, the following segments smooth, polished, the third with a transverse suture, the bottom of which is faintly aciculated.

Hab. St. Vincent.

Described from a single specimen, taken at 1500 feet altitude.

HETEROSPILUS VARIEGATUS, sp. n.

♂ ♀. Length 2 to 3½ millim.; ovipositor about as long as the abdomen. Pale ferruginous to luteous, sutures of thorax, metathorax, and upper portion of four or five basal abdominal segments black; antennæ pale brown; legs white. Head with faint transverse aciculations on the vertex. Thorax very faintly shagreened, the parapsidal furrows distinct, the middle lobe

rugose posteriorly; metapleura with a crenulate furrow across the disk; metapleura areolated, the central diamond-shaped area rugose, the two large basal areas shagreened. Wings subhyaline, the transverse nervures between the second and third submarginal cells subobsolete. Abdomen as long as the head and thorax together, the first segment and the basal two-thirds of the second striated, the three following segments finely punctate along the base; the second segment is longer than the first in the male, shorter in the female.

Hab. St. Vincent.

Described from one male and two female specimens.

Heterospilus humeralis, sp. n.

♂ ♀. Length 2 to $2\frac{1}{2}$ millim.; ovipositor shorter than the abdomen. Pale ferruginous, the mesopleura, humeri, and base of metathorax more or less fuscous or dusky; legs white or luteous. Head smooth, transversely aciculated on vertex. Thorax faintly shagreened, the parapsides distinct, the middle lobe roughened posteriorly; metathorax rugose, areolated. Wings subfuscous; the stigma large, brown; the venation pale. Abdomen not longer than the head and thorax together, the first and second segments about equal, longitudinally striated, except the apex of the second, which is smooth and polished, the third segment aciculated at base, rest of the abdomen smooth, shining.

The male in structure and colour closely resembles the female, except the apex of the abdomen is slightly embrowned and the mesopleura are smoother and more shining.

Hab. St. Vincent.

Described from 1 male, 7 female specimens.

Lysitermus, *Förster*.

Table of Species.

Pale ferruginous; wings hyaline; the last antennal joint not white .... *L. terminalis*.

Dark brown; wings with a transverse band; the last antennal joint white.............................. *L. fascipennis*.

Lysitermus terminalis, sp. n.

♀. Length $1\frac{1}{2}$ millim.; ovipositor half the length of the abdomen. Pale ferruginous, smooth, polished; mesopleura, apical half of abdomen, and ovipositor black; legs pale yellow.

Head subglobose, the eyes brown. Antennæ 17-jointed, longer than the body. Mesonotum with two punctate furrows that converge and meet before the scutellum, the middle lobe finely, sparsely punctate, truncate anteriorly with acute angles. Mesopleura with a crenulate fovea near the middle. Metathorax finely rugose, with a delicate central longitudinal keel and lateral keels. Wings hyaline, the margins with short cilia, the venation brown, and with only two submarginal cells; stigma distinct, the first branch of radius long, the second branch extending to the apical margin, the marginal cell therefore large. Abdomen oblong-oval, depressed, polished, blackish towards apex, and composed of only three visible segments.

Hab. St. Vincent.

Described from a single specimen.

LYSITERMUS FASCIPENNIS, sp. n.

♀. Length $1\frac{1}{4}$ millim.; ovipositor two thirds the length of the abdomen. Dark reddish brown, polished, impunctate; meso- and metapleura and apical half of the abdomen black; legs honey-yellow, the apical half of the posterior femora embrowned. Head subglobose, the eyes oval, brown. Antennæ 14-jointed, fuscous, the four basal joints yellowish, the apical joint white. Mesonotum without furrows, smooth, polished, the anterior angles acute. Metathorax finely rugose, with a central longitudinal keel and lateral keels. Wings hyaline, with a transverse brown band below the stigma, and of the same width. Abdomen oblong-oval, polished, of three segments, the first finely aciculated or striated.

Hab. St. Vincent.

Described from a single specimen.

Subfamily PAMBOLINÆ.

PAMBOLUS, *Haliday.*

PAMBOLUS ANNULICORNIS, sp. n.

♀. Length $2\frac{1}{2}$ millim.; ovipositor about half the length of the abdomen. Black, polished; head transverse, the face below the antennæ finely punctate. Antennæ dark brown, the two basal joints and a broad band beyond the middle honey-yellow. Thorax smooth, impunctate, the parapsidal furrows distinct, converging posteriorly, the middle lobe with two short carinæ posteriorly; scutellum polished, with five foveæ at base; mesopleura finely punctulate, with an oblique, crenulate furrow

anteriorly; metathorax rugose, with two areas at base. Wings hyaline, the second and third submarginal cells confluent. Legs, including coxæ, honey-yellow. Abdomen sessile, oblong-oval, the second segment longer than the first, with a cross-furrow at about its middle; the first segment, basal two-thirds of the second, and the third at base longitudinally striated.

Hab. St. Vincent.

Described from a single specimen.

DIMERIS, *Ruthe.*

DIMERIS MACULIPENNIS, sp. n.

♂. Length 1 millim. Brown, the head blackish on the vertex. Antennæ 16-jointed, pale. Thorax smooth, narrowed in front, with two delicate furrows that converge and meet before attaining the base of the scutellum. Scutellum with a large fovea across the base. Metathorax finely rugose, areolated. Wings subfuscous, with spots at base, across the middle, and in the radial cell white. Abdomen finely punctate, composed of three segments, the first the longest, the third the shortest. Legs honey-yellow, tips of posterior femora and tibiæ brown.

Hab. St. Vincent.

Described from a single specimen.

Subfamily RHOGADINÆ.

RHOGAS, *Nees.*

RHOGAS PECTORALIS, sp. n.

♂ ♀. Length 4 to 5 millim. Black, opaque, closely, finely punctulate; the mouth-parts, legs, and thorax beneath honey-yellow. Wings fuliginous, the first branch of radius as long as the second. Metathorax, the first, second, and basal half of the third abdominal segment with a delicate central keel; the fourth and following segments slightly shining. Ovipositor in female very slightly exserted.

Hab. St. Vincent.

Described from one female and four males, taken at an altitude of 1500 feet.

CLINOCENTRUS, *Haliday.*

CLINOCENTRUS FLAVIVENTRIS, sp. n.

♂. Length 3½ to 4½ millim. Entirely black, shining, pubescent; the apex of abdomen, along the sides, and the venter alone,

yellow. Head transverse, smooth above; orbits and face, below antennæ, punctate. Palpi fuscous. Antennæ 36-jointed, longer than the body. Thorax trilobed, the middle lobe posteriorly rugose, the mesopleura with a smooth space on the disk. Scutellum smooth, with two large, confluent foveæ at base. Metathorax coarsely rugose. Wings fuliginous. Abdomen compressed along the venter and slightly at tip, the first and second segments above black, striated, the following segments smooth, the third with a black spot at base and showing some faint transverse aciculations.

Hab. St. Vincent.

Described from five specimens, taken at an altitude of 500 feet.

Subfamily Cheloninæ.

Phænotoma, *Wesmael*.

Table of Species.

Pale ferruginous or honey-yellow, varied more or less with fuscous.	
Thorax trilobed..................................	2.
Thorax not trilobed.	
Occiput deeply emarginated; first branch of radius distinctly longer than the second	*P. insularis.*
Occiput not deeply emarginated; first branch of radius half the length of the second	*P. humeralis.*
2. First branch of radius as long as or longer than the second. First transverse cubital nervure not interstitial with the recurrent nervure, but joined to the cubital nervure	*P. meridionalis.*
First transverse cubital nervure interstitial	*P. fuscovaria.*

Phænotoma insularis, sp. n.

♂. Length 4 millim. Pale ferruginous, closely, finely punctulate; a spot back of eyes and ocelli, the humeri, a spot on middle of thorax, collar beneath, the bottom of the impression at sides, the sternum, spot beneath tegulæ, and metathorax and the abdomen above except an oblong discal spot, a spot on middle and posterior femora beneath near the apex, and the posterior tibiæ, except just at base, fuscous. Antennæ 23-jointed, tapering at tips. Head broader than the thorax, deeply excavated posteriorly. Thorax without furrows; scutellum triangular; metathorax short, finely rugose, with a slight keel on the superior edge of the posterior face connected with delicate lateral keels, the disk without keels. Wings subhyaline, mottled with whitish

spots, the venation brown, the stigma with a large yellowish streak; the first branch of the radius longer than the second, the first transverse cubital nervure interstitial with the recurrent nervure.

Hab. St. Vincent.

Described from a single specimen, taken at an altitude of 2000 feet. The species approaches closest to *P. tibialis*, Hal., but is decidedly different in the venation.

PHÆNOTOMA HUMERALIS, sp. n.

♂. Length 4 millim. Pale ferruginous, closely, finely punctulate; shoulders, the depressions at sides of scutellum, and apex of metathorax fuscous. Head transverse, the occiput scarcely emarginated. Antennæ 24-jointed, acuminated at tips, pale ferruginous, the four or five small apical joints black. Thorax without furrows, the disk flattened. Metathorax with a slight carina on the superior edge of the posterior face, the face itself rugose. Wings hyaline, the venation pale, the costal edge and stigma darker, the latter with a pale streak in the middle; first branch of radius only half the length of the second, the first transverse cubital nervure interstitial with the recurrent nervure and at the junction very pale. Legs pale. Abdomen of three segments, the last segment the longest.

Hab. St. Vincent.

Described from a single specimen. The pale colour, shape of the head, and the shortness of the first branch of the radius readily distinguish the species.

PHÆNOTOMA MERIDIONALIS, sp. n.

♂. Length 3 to 4 millim. Pale ferruginous or honey-yellow, finely, closely punctulate, with fuscous or black markings on thorax; the metathorax and upper surface of the abdomen black or fuscous; sometimes the latter has a rounded yellow discal spot, sometimes it is pale with an irregular, central stripe; the metathorax usually has two pale spots at base. Head large, transverse, excavated posteriorly, with the stemmaticum black. Antennæ pale, multiarticulate. Thorax with the parapsidal furrows obsolete posteriorly before reaching the base of the scutellum. Axillæ meeting as a slender line before the base of the scutellum. Metathorax rugose, with an irregular carina on the superior edge of the posterior face. Legs pale. Wings subhyaline, the venation pale brownish, some of the nervures

more or less tinged with yellow; the first branch of the radius equal to the second, or very slightly longer; the first transverse cubital nervure is not interstitial with the recurrent nervure, but joins the cubital nervure. Abdomen of three segments, the first and last about equal, the second the shortest, all striate-rugose.

Hab. St. Vincent.

Described from five specimens, taken at an altitude of 500 feet. The species is near *P. humeralis*; but the distinct parapsidal furrows, the length of the first branch of the radius, and in that the first transverse cubital nervure joins the cubital nervure, separate it at once from the foregoing and the following species.

PHÆNOTOMA FUSCOVARIA, sp. n.

♂ ♀. Length $2\frac{1}{2}$ to 4 millim. Pale ferruginous or honey-yellow, finely rugose-punctate, with variable fuscous markings; sometimes it is wholly pale, with only the apex of the antennæ and the abdomen fuscous; sometimes there is a central fuscous stripe on the mesonotum, metathorax, and abdomen, the scutellum being wholly fuscous; sometimes the mesopleura, metathorax, tip of abdomen, apex of posterior tibiæ and their tarsi are dusky or fuscous, although usually the legs are of a uniform pale colour. Wings greyish-hyaline, the venation brown; the first and second branches of the radius about equal in length, while the first cubital nervure is always interstitial with the recurrent nervure. Abdomen of three segments, the first and third segments about equal, the second a little shorter, all striate-rugose, the first with two distinct keels above.

Hab. St. Vincent.

Described from 31 specimens.

CHELONUS, *Jurine*.

CHELONUS MERIDIONALIS, sp. n.

♂ ♀. Length $2\frac{1}{2}$ to 3 millim. Black, rugose, covered with a sparse, sericeous pubescence. Antennæ 16-jointed, the two basal joints yellowish, or at least beneath. Thorax, in the middle posteriorly, coarsely rugose. Scutellum smooth, polished, with a row of coarse punctures across the base. Metathorax with two median keels connected with a keel on the superior edge of the posterior face, the angles slightly prominent. Legs honey-yellow, all coxæ, middle and posterior femora, the apical half of their tibiæ, and four apical joints of their tarsi black or fuscous.

Wings hyaline, the apical half faintly dusky; the venation, except the costa and median veins which are yellow, brown; the first branch of the radius is shorter than the second, the first transverse cubital nervure a little longer than the recurrent nervure. Abdomen one solid carapace, rugose, with two short keels at base; ovipositor slightly exserted. In the male the antennæ are 20-jointed, all the femora black, while the abdomen has a slight transverse slit at apex.

Hab. St. Vincent.

Described from 10 specimens.

Subfamily RHYSSALINÆ.

RHYSSALUS, *Haliday*.

RHYSSALUS CÆNOPHANOIDES, sp. n.

♂. Length $2\frac{1}{2}$ millim. Pale ferruginous, smooth, shining; tip of abdomen piceous. Antennæ black, the two basal joints pale. Thorax trilobed, the middle lobe with a grooved line posteriorly. Scutellum with a crenate furrow across the base. Metathorax finely rugose, areolated. Legs honey-yellow. Wings greyish-hyaline, the venation brown, the second submarginal cell quadrate; the first branch of the radius about one half the length of the second, the recurrent nervure not interstitial with the first transverse cubital nervure. Abdomen as long as the head and thorax together, oblong-oval, the first and second segments striated, the following smooth, polished, the third with a transverse crenate furrow.

Hab. St. Vincent.

Described from a single specimen, taken at 500 feet altitude.

RHYSSALUS MELLEUS, sp. n.

♂ ♀. Length $1\frac{1}{2}$ to 2 millim.; ovipositor one third the length of the abdomen. Honey-yellow, the apical half of the abdomen brownish. Antennæ 15-jointed. Thorax with two distinct furrows, the scutellum crenate at base, the metathorax areolated. Wings hyaline, the venation pale brown, a yellowish spot at base of stigma; the first branch of the radius is a little shorter than the second, the recurrent nervure interstitial with the first transverse cubital nervure. Abdomen subpetiolate, smooth and polished, the first segment with lateral carinæ and slightly roughened.

The male, or what is taken to be the male of this species, has 17-jointed antennæ, white legs, while the mesopleura, scutellum, metathorax, and base and apex of the abdomen are black or fuscous; the middle thoracic lobe has a central impressed line; while the wings are subhyaline with a yellowish spot across the base of the stigma and the first submarginal cell.

Hab. St. Vincent.

Described from 1 female, 4 male specimens.

RHYSSALUS BRUNNEIVENTRIS, sp. n.

♀. Length 3 millim.; ovipositor longer than half the length of the abdomen. Pale ferruginous; a blotch beneath anterior wings, and the abdomen reddish brown. Antennæ multi-articulate, pale brown. Thorax faintly shagreened, indistinctly trilobed, pubescent; the scutellum with two foveæ at base, separated by a raised line. Metathorax finely shagreened, not areolated. Wings subhyaline, the venation pale brownish; the first branch of radius not half the length of the second, the recurrent nervure not interstitial with the transverse cubital nervure but joins the cubitus some distance from its apex. Abdomen ovate, the length of the thorax, smooth and shining, the first segment finely sculptured.

Hab. St. Vincent.

Described from a single specimen. On account of the non-areolated metathorax this species does not agree with all the generic characters laid down for *Rhyssalus*, agreeing in this respect with the genus *Colastes*, Haliday; but as all of the other characters agree with *Rhyssalus* and not with *Colastes*, I have placed it in the former genus.

Subfamily AGATHIDINÆ.

AGATHIS, *Latreille*.

AGATHIS RUBRICINCTUS, sp. n.

♂ ♀. Length $3\frac{1}{2}$ to 5 millim.; ovipositor longer than the body. Black, shining, punctate, covered with a cinereous pubescence, especially on the face, side of thorax, and the coxæ; the second abdominal segment with a broad reddish-yellow band. Head transverse rostriform, the vertex with a grooved line from the lateral ocellus to the margin of the eye; ocelli red. Antennæ black, involuted at tips. Thorax trilobed, punctate; scutellum

with a crenate furrow at base; metathorax rugose, with a central carina. Legs black, the anterior pair (except coxæ, trochanters, and two apical joints of tarsi) rufous; apical half of middle femora and base of their tibiæ rufous; a spot at base of posterior tibiæ, and all tibial spurs rufous. Wings hyaline, the venation brown-black. Abdomen black, polished, except the two basal segments which are finely shagreened, and the basal two-thirds of the second segment which is reddish yellow.

Hab. St. Vincent.

Described from 1 male, 14 female specimens.

AGATHIS PECTORALIS, sp. n.

♂ ♀. Length 5 millim.; ovipositor half the length of body. Rufous; head, collar beneath, mesosternum, and legs black, the tips of anterior femora and their tarsi and the middle tarsi rufous. Thorax trilobed, impunctured; the scutellum with a deep depression across the base, separated into two parts by a raised line at the middle; metathorax rugose, with some delicate longitudinal keels. Wings fuliginous, with two or three white spots below the base of the stigma; areolet subquadrate. Abdomen elongate, smooth, polished, impunctured.

Hab. St. Vincent.

Described from 2 female, 12 male specimens.

MICRODUS, *Nees.*

MICRODUS SMITHII, sp. n.

♂ ♀. Length 2 to $2\frac{1}{5}$ millim.; ovipositor a little longer than abdomen. Black, polished; legs yellow; abdomen black, in male with a broad yellow band at the middle, in the female with a broad band before the middle and the apex yellow. Thorax trilobed, smooth, shining, pubescent; metathorax rugose, with two close central parallel keels on the disk. Wings hyaline, the venation brown. Abdomen, except the first segment, which is finely sculptured and grooved along the sides, smooth and polished.

Hab. St. Vincent.

Described from one male and one female.

MICRODUS UNICINCTUS, sp. n.

♀. Length 3 millim.; ovipositor as long as the body. Black, polished, the face piceous, the second abdominal segment yellow;

four anterior legs honey-yellow; the posterior legs black, their tibiæ with a broad white band at the middle; all tibial spurs white. Thorax trilobed, furrows deep; scutellum with a deep impressed line across the base; metathorax very finely shagreened, without carinæ. Wings hyaline, the venation brown, the areolet triangular. Abdomen about as long as the head and thorax together; except the first segment, which is finely shagreened, and the second, which is yellow, black, smooth and shining.

Hab. St. Vincent.

Described from a single specimen.

MICRODUS INSULARIS, sp. n.

♂ ♀. Length 3 to 4 millim.; ovipositor two thirds the length of body. Pale ferruginous; stemmaticum extending posteriorly on the occiput; longitudinal bands on lateral lobes of thorax, metathorax above, base and apex of abdomen, ovipositor, antennæ, and posterior tibiæ and tarsi, except a pale streak on tibiæ above and an annulus at base, black. The furrows of thorax are crenate; the metathorax coarsely rugose, with a central furrow; the first abdominal segment keeled laterally and finely longitudinally striated basally two thirds of its length, while the posterior tibiæ are contracted at base. Wings hyaline, iridescent, the venation dark brown, the areolet triangular, open behind.

Hab. St. Vincent.

Described from one male and two female specimens.

ORGILUS, *Haliday*.

ORGILUS PALLIDUS, sp. n.

♀. Length $4\frac{1}{2}$ millim.; ovipositor about as long as the abdomen. Honey-yellow; the antennæ above, middle tarsi, the second joint of posterior trochanters, spot at apex of femora, their tibiæ above and tarsi, fuscous or black. Thorax trilobed, the furrows crenate; the metathorax smooth, without carinæ. Wings greyish-hyaline, the venation brown; the marginal cell closed, extending nearly to the apex of the wing; the first cubital and first submarginal cells distinct, not confluent; the areolet triangular, the outer nervure pale.

Hab. St. Vincent.

Described from a single specimen.

Subfamily Calyptinæ.

Calyptus, *Haliday*.

Calyptus thoracicus, sp. n.

♀. Length 5 millim.; ovipositor longer than the body. Black, shining; thorax, excepting metathorax, and anterior coxæ and trochanters orange-red. Face with pale pubescence. Mandibles pale. Antennæ about 35-jointed, attenuated and involuted at tips. Thorax with the parapsidal furrows broad and deep posteriorly; the scutellum convex, with two large foveæ at base, separated only by a carina. Metathorax rugose, coarsely areolated. Legs black, pubescent. Wings hyaline, the venation black. Abdomen with four segments, shining, the first and second striated; the first with two carinæ, the third and fourth smooth, polished.

Hab. St. Vincent.

Described from a single specimen, taken in August at an altitude of 500 feet. A most beautiful and easily recognized species, distinguished at once by its orange-red thorax.

Subfamily Blacinæ.

Blacus, *Nees*.

Blacus rubriceps, sp. n.

♂. Length $2\frac{1}{2}$ millim. Black, polished; head red, ocelli black. Antennæ 26-jointed, black, the two basal joints pale. Thorax smooth, with two delicate furrows that converge and meet a little beyond the middle of the mesonotum; the mesonotum is flattened posteriorly in front of the scutellum. Scutellum convex, with an impressed cross line at base. Mesopleura smooth, polished. Metathorax smooth, impunctured, with a central carina. Legs rufous. Wings hyaline, the venation brown-black; the recurrent nervure not interstitial with the transverse cubital nervure. Abdomen black, smooth, and polished.

Hab. St. Vincent.

Described from a single specimen taken in May.

Ganychorus, *Haliday*.

Ganychorus collaris, sp. n.

♀. Length 2 millim. Black, polished, the antennæ, collar, and legs reddish yellow, the posterior femora dusky toward tips. Antennæ 20-jointed, the last joint large, fusiform. Thorax smooth, with two distinct furrows; collar, sternum, and meta-

thorax rugose, the latter with two large areas on disk, the surface of which is smooth. Wings greyish-hyaline, the venation pale brown; the recurrent nervure almost interstitial with the first transverse cubital nervure, the cubitus extending to the apical margin of the wing, the marginal cell therefore very large. Abdomen smooth, the first segment with lateral grooves, the second segment piceous; ovipositor about half the length of the abdomen.

Hab. St. Vincent.

Described from a single species.

Subfamily Liophroninæ.

Liophron, *Nees*.

Liophron minutus, sp. n.

♂ ♀. Length $1\frac{1}{5}$ to $1\frac{1}{2}$ millim. Black, highly polished; antennæ and legs in male yellowish; apical half of abdomen and antennæ in female piceous. Head transverse, the face with short, sparse, white hairs. Antennæ in female 20-jointed, in male 15-jointed. Thorax with the parapsides distinct, the scutellum foveated at base. Metathorax smooth, delicately areolated. Wings hyaline, the venation pale yellowish, the costa and stigma brown, the marginal cell about as long as the stigma; the first branch of the radius very short, the recurrent nervure joining the first submarginal cell. Abdomen in female smooth, the first segment with lateral grooved lines, the ovipositor very short; in male the first segment and the basal half of the second aciculated.

Hab. St. Vincent.

Described from one male and two female specimens.

Subfamily Toxoneurinæ.

Toxoneura, *Say*.

Toxoneura atricornis, sp. n.

♂ ♀. Length $3\frac{1}{2}$ to 5 millim. Sanguineous to reddish yellow; the vertex of head and tip of abdomen dusky or black; antennæ, sheaths of ovipositor, tips of middle tibiæ, and posterior knees, tips of their tibiæ, and tarsi black or fuscous, the basal tarsal joint usually pale at base. Wings fuliginous. Sometimes the whole upper surface of the abdomen is dusky or brown, and occasionally it is entirely pale, concolorous with the thorax.

Hab. St. Vincent.

Described from 51 specimens.

Subfamily OPIINÆ.

GNAMPTODON, *Haliday*.

GNAMPTODON? ATRICAUDUS, sp. n.

♀. Length $1\frac{1}{2}$ millim.; ovipositor as long as the abdomen. Pale ferruginous, finely shagreened. Head transverse, the occiput margined. Antennæ slightly dusky towards tips. Thorax with two deep furrows, with sparse white hairs along the margins. Scutellum with a crenate furrow at base. Mesopleura with an oblique furrow below the middle. Metathorax finely rugose, indistinctly areolated. Wings hyaline, the venation pale; the first branch of radius very little shorter than the second, the recurrent nervure interstitial with the first transverse cubital nervure, the submedian cell slightly longer than the median. Abdomen elongate-oval, the first segment and basal two-thirds of the second finely rugose and striated, the second with a transverse furrow, the apex and the following segments smooth.

Hab. St. Vincent.

Described from two specimens.

This species does not agree exactly with the definition for the genus *Gnamptodon*, having the occiput margined and only one transverse suture on the second abdominal segment. In having the occiput margined it agrees with *Ademon*, Hal., but in all other characters it does not agree, and in my perplexity I have placed it doubtfully in *Gnamptodon*.

OPIUS, *Wesmael*.

Table of Species.

Mesonotum with furrows, or at least trilobed ...... 3.
Mesonotum without furrows, not trilobed.
Recurrent nervure interstitial with the first transverse cubital nervure, or joining the first submarginal cell .... 2.
Recurrent nervure not interstitial, or joining an angle in the second submarginal cell.
Black, legs pale; the third abdominal segment longer than the first .... *O. Salvini.*
Honey-yellow, the head black; second and third abdominal segments equal, shorter than the first .... *O. melanocephalus.*
Entirely honey-yellow; second abdominal segment short, with oblique foveæ at base .... *O. insularis.*

2. Black; second abdominal segment with a yellow band, longer than the first .... *O. unifasciatus.*
 Honey-yellow or pale ferruginous, the tip of the abdomen sometimes very dusky.
  Second abdominal segment not longer than the first; the recurrent nervure interstitial .... *O. interstitialis.*
  Second abdominal segment shorter than the first; the recurrent nervure rejected .... *O. rejectus.*

3. Pale ferruginous or honey-yellow, head and apex of abdomen black or brown.
  Antennæ not ringed with white; recurrent nervure not interstitial .... *O. atriceps.*
  Antennæ ringed with white; recurrent nervure interstitial .... *O. annulicornis.*

OPIUS SALVINI, sp. n.

♂ ♀. Length $1\frac{1}{2}$ to 2 millim.; ovipositor much longer than the abdomen. Black, shining, impunctured, rarely with the disk of thorax, metathorax, and a spot on second abdominal segment brown; legs and two basal joints of antennæ honey-yellow or reddish yellow, the rest of the antennæ varies from brown to black. In the female the antennæ are 23-jointed, in the male 21- to 26-jointed. Thorax smooth, without furrows. Scutellum foveated at base. Mesopleura with a crenate furrow. Metathorax rugose. Wings hyaline, iridescent, the venation dark brown; the first branch of the radius very short, the recurrent nervure not interstitial, joining an angle in the second submarginal cell. Abdomen oval, in the female the first and second segments about equal, the third the largest; in the male the second segment is the longest; the third segment is roughened, the following smooth, polished.

Hab. St. Vincent.

Described from 30 specimens.

OPIUS MELANOCEPHALUS, sp. n.

♂ ♀. Length 1 to 2 millim.; ovipositor less than one third the length of the abdomen. Honey-yellow, smooth, impunctured; the head always black with the face sometimes pale, and sometimes in the male the abdomen, except the base, is sometimes brown or black. Antennæ in female 24-jointed, in male 22- or 27-jointed, variable from a honey-yellow to brown. Thorax smooth, without furrows; the scutellum foveated at base; the mesopleura with a crenate furrow, the metathorax areolated or

rugose. Wings greyish-hyaline, the venation brown; the first branch of the radius very short, the recurrent nervure not interstitial, joining an angle in the second submarginal cell. Abdomen oval, the second and third segments equal, shorter than the first, the first carinated and with a groove at the sides; rest of the abdomen smooth, polished.

Hab. St. Vincent.

Described from 20 specimens.

Opius insularis, sp. n.

♂ ♀. Length 1 to 2 millim.; ovipositor short. Entirely honey-yellow, smooth and polished; the male abdomen black toward apex. Antennæ in female 19- to 26-jointed, black, the two basal joints pale; in male 24- to 27-jointed. Thorax smooth, without furrows, the scutellum foveated at base, the mesopleura with a crenate furrow, metathorax rugose or areolated. Wings hyaline, the venation pale brown; the first branch of radius very short, the recurrent nervure joining an angle in the second submarginal cell. Abdomen oval, the first segment roughened, with grooved lines at sides, the following segments smooth, polished, the second segment shorter than the first, with two oblique foveæ at base.

Hab. St. Vincent.

Described from 11 specimens.

Opius unifasciatus, sp. n.

♂. Length $2\frac{1}{2}$ millim. Black, polished; the basal two-thirds of second abdominal segment, two basal joints of antennæ, and legs yellow. Antennæ 29-jointed. Thorax smooth, polished, without furrows, the scutellum with a crenate furrow along the base, a crenate furrow on the mesopleura, and the metathorax coarsely rugose. Wings hyaline, iridescent, the venation brown; the first branch of the radius short, the recurrent nervure interstitial with the first transverse cubital nervure. Abdomen oval, smooth, polished, the second segment longer than the first, striated, furrowed at sides.

Hab. St. Vincent.

Described from a single specimen.

Opius interstitialis, sp. n.

♂ ♀. Length 1 to 2 millim.; ovipositor very short, scarcely exserted. Entirely honey-yellow, seldom with the tip of the

abdomen dusky. Antennæ, except the two basal joints, fuscous or black. Thorax polished, without furrows, the scutellum with a crenate furrow at base, mesopleura with a crenate furrow, and the metathorax finely rugose and areolated. Wings hyaline, the venation fuscous or brown; the recurrent nervure insterstitial with the first transverse cubital nervure, the submedian cell slightly longer than the median. Abdomen oval, polished, the first segment longer than the second, sculptured with furrows along the sides, the second with two oblique foveæ at base.

Hab. St. Vincent.

Described from 51 specimens.

OPIUS REJECTUS, sp. n.

♂ ♀. Length $1\frac{1}{2}$ to 2 millim.; ovipositor about one third the length of the abdomen. Entirely honey-yellow, the antennæ alone black. Antennæ in female 27-jointed, in male 21-jointed. Thorax smooth, polished, without furrows, the mesopleura without a furrow, and the metathorax smooth, not areolated. Wings greyish-hyaline, the venation brown; the first branch of the radius longer than in the foregoing species, while the recurrent nervure joins the first submarginal cell. Abdomen smooth, polished, the first segment longer than the second, with furrows along the sides, but the disk smooth.

Hab. St. Vincent.

Described from two specimens, a male and a female.

OPIUS ATRICEPS, sp. n.

♂. Length $1\frac{1}{2}$ to $1\frac{4}{5}$ millim. Honey-yellow; head and apical half of abdomen, or at least the tip, black or brown, variable, the face usually pale. Antennæ fuscous, pale toward base. Thorax smooth, with distinct parapsidal furrows; the scutellum foveated at base, or areolated. Legs yellowish white. Wings subhyaline, the venation dark brown; the recurrent nervure not interstitial, joining the first submarginal cell. Abdomen ovate, smooth, the first segment the longest, striated.

Hab. St. Vincent.

Described from three specimens.

OPIUS ANNULICORNIS, sp. n.

♂ ♀. Length 2 millim.; ovipositor short. Honey-yellow; the head and apex of abdomen brownish or black. Antennæ black, yellow toward base, with a white annulus beyond the

middle. Thorax smooth, with distinct parapsidal furrows, the scutellum with a crenate furrow across the base, a crenate furrow on the mesopleura, and the metathorax rugose or areolated. Legs yellowish white. Wings hyaline, the venation brown, the recurrent nervure interstitial. Abdomen oblong-ovate, smooth, shining, the first segment the longest, striated.

Hab. St. Vincent.

Described from three specimens.

DIACHASMA, *Förster*.

DIACHASMA PILOSIPES, sp. n.

♂ ♀. Length 2 millim. Pale honey-yellow; the eyes large, round, brown. Legs whitish, pilose. Thorax microscopically shagreened, without furrows, the disk somewhat flat. Scutellum with a fovea at base, the bottom with a central raised line. Mesopleura smooth, without a furrow. Metathorax smooth, with a central carina. Abdomen linear, smooth, the first segment the longest. Wings hyaline, the venation pale or yellowish, the recurrent nervure interstitial with the first transverse cubital nervure.

Hab. St. Vincent.

Described from three specimens.

Subfamily ALYSINÆ.

PHÆNOCARPA, *Förster*.

PHÆNOCARPA PLEURALIS, sp. n.

♀. Length $1\frac{4}{5}$ millim. Head, mesopleura, and disk of abdomen black; thorax and abdomen, with the exceptions noted, honey-yellow; legs white. Wings hyaline, the venation pale brown. Metathorax areolated. First abdominal segment a little wider than long, with two delicate carinæ on disk; rest of the abdomen smooth, polished; the ovipositor very short, scarcely projecting.

Hab. St. Vincent.

Described from a single specimen, having the antennæ broken.

Subfamily APHIDIINÆ.

LYSIPHLEBUS, *Förster*.

LYSIPHLEBUS MERIDIONALIS, sp. n.

♀. Length $1\frac{1}{2}$ millim. Black, polished; legs, mandibles, and petiole of abdomen pale brown. Antennæ 13-jointed, black, the

two basal joints pale beneath, the second with a pale ring at apex; funicle-joints about two and a half times as long as thick, the last a little longer than the first. Wings hyaline, the venation pale brown, the second branch of the stigmal vein longer than the transverse cubitus.

Hab. St. Vincent.

Described from a single specimen taken at 1500 feet altitude.

Family ICHNEUMONIDÆ.

Subfamily Cryptinæ.

Mesostenus, *Grav.*

Mesostenus insularis, sp. n.

♂ ♀. Length 5 to 10 millim.; ovipositor 3 to $3\frac{1}{2}$ millim. Head, antennæ, thorax, and ovipositor black; the orbits broadly, cheeks, face below antennæ, clypeus, labrum, spot at base of mandibles, palpi, a broad annulus on antennæ, upper margin of collar, spot before front coxæ, anterior and middle coxæ and trochanters, spot on posterior coxæ behind at base, tegulæ, spot below, second joint of posterior tarsi, and scutellum white. Legs and abdomen rufous, the tarsi black or fuscous. Head smooth, impunctured, with a central carina from front ocellus. Thorax shining, sparsely punctate, the parapsidal furrows distinct, crenulated, the middle lobe with longitudinal striæ posteriorly; metathorax with two transverse keels, the posterior angles slightly compressedly toothed, the enclosed space at base smooth, the space between the first and second transverse keels coarsely longitudinally striated, the posterior face very coarsely rugose, metapleura with coarse transverse striæ. The mesopleura below and the metathorax more or less densely covered with a glittering white, appressed pubescence. Wings hyaline, the venation piceous, the areolet quadrate. Abdomen with three basal segments, finely microscopically punctulate. In the male the annulus on the antennæ is narrower, the white spot at base of posterior coxæ wanting; the second, third, and fourth joints of posterior tibiæ are usually white, although sometimes only the second joint is white or the first partially white, and in a single case the tarsi are wholly dusky. The metathorax is more rounded behind than in the female, the lateral angles not at all toothed, while the abdomen is smooth, impunctured.

Hab. St. Vincent.

Described from a large series, 21 specimens, taken from 500 to 1500 feet altitude. It is very variable in size, in the width of the annulus on antennæ, and in the white on the posterior tarsi.

Subfamily Ophioninæ.

Nototrachys, *Marshall.*

Nototrachys niger, sp. n.

♂ ♀. Length $8\frac{1}{2}$ to 9 millim. Entirely black, except a lateral spot on the fourth abdominal segment, and the second, third, and fourth ventral segments, anterior legs (except coxæ and trochanters), and tibial spurs, which are rufous; the female antennæ are annulated with white. Head, before, rugose, with a central carina extending from the front ocellus; mesonotum with shallow, crenulated furrows, the middle lobe rugose; metathorax reticulately rugose, with two semicircular areas at base. Wings hyaline, the tips slightly smoky, the venation brown-black.

Hab. St. Vincent.

Described from one male and one female. The male was taken in a dry scrubby forest near Cumberland, seaward, Sept. 30th, at an altitude of 500 feet; the female at 2000 feet altitude.

Nototrachys minimus, sp. n.

♂ ♀. Length $4\frac{1}{2}$ to 5 millim. Differs from *N. niger* in its smaller size, the frons with a white orbital spot, in both sexes opposite the antennæ; the anterior and middle legs, including coxæ, and the whole side of the fourth abdominal segment rufous; the mesonotum punctate; the metathorax with two transverse carinæ; otherwise in the white annulus on the antennæ and in its wing-characters it agrees with *N. niger*.

Hab. St. Vincent.

Described from one female and two male specimens. The white orbital spot and the rufous anterior and middle legs readily distinguish the species.

Campoplex, *Grav.*

Campoplex meridionalis, sp. n.

♂ ♀. Length $6\frac{1}{2}$ to $7\frac{1}{2}$ millim. Black, covered with a fine, sericeous pubescence; mandibles, palpi, scape beneath, and anterior and middle coxæ and trochanters yellowish white, the coxæ

with a spot before; legs rufous, the middle tarsi fuscous, posterior legs, including coxæ, black; claws pectinated. Antennæ nearly as long as the body, black. Thorax closely punctulate; metathorax areolated rugose, the middle area with transverse raised lines. Abdomen one and a half times as long as the head and thorax together, compressed, black, the sides of segments 4, 5, and 6 and the venter rufous; the petiole longer than the second segment, swollen at tip, smooth, shining, and impunctured, the following segments closely, finely, microscopically punctate. Wings subhyaline, the venation black, the areolet small, petiolate.

The female differs from the male only in having an ovipositor 3 millim. long, and in that the apical half of the abdomen, beginning from the middle of the third segment, is entirely rufous. The wing-areolet is also more distinct.

Hab. St. Vincent.

Described from 2 female, 6 male specimens, taken on west slope, Gonfrière, Sept. 23, in a forest at an altitude of 1800 feet.

Cremastus, *Grav.*

Cremastus (?) insularis, sp. n.

♀. Length 5 millim.; ovipositor 2 millim. Honey-yellow; antennæ except scape, spot at base of metathorax, base and tip of posterior tibiæ, apex of abdomen, first, second, and base of third abdominal segments black; the sutures of the first, second, third, and fourth antennal joints pale. Eyes very large, oval, occupying the whole side of the head, and extending to base of mandibles. Thorax trilobed, middle lobe prominent. Metathorax sloping posteriorly, areolated. Wings hyaline, iridescent, the venation dark brown, areolet oblique, petiolated.

Hab. St. Vincent.

Described from a single specimen, taken in a damp forest in Petite Bordelle Valley, Oct. 23. This is not a true *Cremastus.*

Mesochorus, *Grav.*

Mesochorus annulitarsis, sp. n.

♂. Length $2\frac{1}{2}$ millim. Yellowish white; lateral lobes of mesothorax, metathorax, annulus at base and apex of posterior femora, and the apex of the first, second, third, and fourth joints of their tarsi, and the last tarsal joint black. Abdomen above (except the apical two-thirds of the second and the basal half of third segment, which are luteous), black, the apex paler; middle lobe

of the thorax fuscous. Antennæ 24-jointed, pale, toward the apex fuscous. Wings hyaline, the venation pale, the cubital vein extending from the areolet to the apical margin of wing entirely wanting.

Hab. St. Vincent.

Described from a single specimen taken at "sea-level." The species comes nearest to *M. americanus*, Cr., than to any other of the North-American species; but can be distinguished from it and other closely allied forms by the annulations on the posterior tarsal joints and the absence of the cubital vein.

Subfamily Tryphoninæ.

Exochus, *Grav.*

Exochus tegularis, sp. n.

♂. Length 5 millim. Honey-yellow, antennæ, a spot on occiput extending forwards and enclosing ocelli, tegulæ, broad band on middle thoracic lobe, spot on the lateral lobes, metathorax above, spot on posterior coxæ beneath, extreme base of posterior tibiæ, and the abdomen above black; venter and sides of second, third and fourth, fifth and sixth abdominal segments honey-yellow, those on the fourth and fifth meeting above and forming a band. Antennæ 30-jointed, straight. Metathorax distinctly areolated. Wings hyaline, the areolet entirely wanting.

Hab. St. Vincent.

Described from a single specimen, and seems to come nearest to the Cuban *E. validus*, Cr.

Orthocentrus, *Grav.*

* *Areolet wanting.*

Orthocentrus variabilis, sp. n.

♂ ♀. Length 2 to 3½ millim. Black, polished, the face pale, rarely in male entirely black; mandibles, palpi, and legs yellowish white or honey-yellow; in one specimen only the posterior coxæ are black, the femora brown, in another the posterior femora and coxæ are brown; sometimes the posterior femora and the tips of the tibiæ are brown. Usually the thorax and abdomen are entirely black, but two or three specimens have the mesonotum pale, and sometimes a pale streak across the second abdominal segment. The antennæ are usually 26-jointed in the male, 22- or 24-jointed in the female, black or dusky,

always pale toward base. The metathorax is smooth, polished, impunctured, not areolated, but with delicate side-keels. Abdomen polished, the venter always pale, the first segment with a depression towards the tip and with some slight raised lines. Wings hyaline, the venation brown, the stigma large, triangular; the areolet entirely absent.

Hab. St. Vincent.

Described from 10 specimens, taken at an altitude of from 500 to 1000 feet. There may be more than one species; but as the specimens at hand are so few and badly mounted, I must leave the question to be settled by future investigators.

** *Areolet present, pentagonal.*

ORTHOCENTRUS INSULARIS, sp. n.

♂. Length 3 to 4 millim. Honey-yellow or luteous; stemmaticum, dot behind cheeks, sides of mesonotum, metathorax and abdomen (except apical half of the second, the whole of third, the base of the fourth and the apical segments) black. The posterior knees, tip of tibiæ, and the extreme tip of the tarsal joints fuscous; rest of the legs white. Antennæ 41-jointed, pale, longer than the body, curled and fuscous at tips. Metathorax rather long, the disk smooth, with two close, central, subparallel, longitudinal carinæ extending from base to apex; the metapleura are bounded by a keel, and the space behind the spiracles is a little roughened and almost enclosed by a carina between the central longitudinal keel and the metapleural keel. Wings hyaline, the venation pale brown, the stigma triangular; the areolet rather large, pentagonal. The two basal abdominal segments are rough, the first with two longitudinal carinæ above, the second segment depressed at the middle, the following all smooth, but more or less punctate.

Hab. St. Vincent.

Described from 7 specimens, taken at an altitude of from 1000 to 1500 feet.

Subfamily PIMPLINÆ.

LAMPRONOTA, *Curtis.*

LAMPRONOTA ALBOMACULATA, sp. n.

♀. Length $7\frac{1}{2}$ millim.; ovipositor 8 millim. Black; abdomen and legs, with the exceptions mentioned below, rufous; face, orbits, cheeks, clypeus, mandibles, palpi, two stripes on meso-

notum, scutellum, postscutellum, spot below tegulæ, posterior tegulæ, two large spots beneath, a longitudinal band on mesopleura, prosternum and collar, anterior coxæ, two spots on mesosternum before the middle coxæ, middle coxæ except a black spot behind, posterior coxæ except a large spot before and behind, and the metapleura, all white. Head transverse, impunctured, shining; ocelli large, red; eyes large, oval, dark brown. Thorax without furrows, smooth, shining, with some sparse punctures on the disk and on the scutellum; metathorax sloping off gradually posteriorly, transversely rugulose, without carinæ. Legs rufous, coxæ white, the middle pair with a black spot before and behind, the first joint of middle and posterior trochanters black, anterior and middle tarsi dark fuscous, approaching black, the middle tibiæ more or less fuscous, extreme tip of posterior femora and their tibiæ and tarsi wholly black, tibial spurs white. Wings hyaline, iridescent, the venation piceous black. Abdomen with the basal and second segments black or dusky at base and apex, with a dusky blotch on the side of the third segment.

Hab. St. Vincent.

Described from a single specimen, taken at an altitude of 2500 feet.

Family CHALCIDIDÆ.

Subfamily Eurytominæ.

Ashmeadia, *Howard*.

(Rileya, *Ashmead.*)

Table of Species.

- Pale or brownish-yellow species .... 2.
- Black species.
  - All coxæ black.
    - Femora toward base brown, rest of legs and the antennal scape brownish yellow.
      - Antennæ in both sexes subclavate, the funicle-joints transverse .... *A. insularis*, sp. n.
    - Legs, except articulations and the tarsi, wholly black.
      - Antennæ in male with the funicle-joints strongly pedicellate-moniliform, with sparse whorls of long hairs; female unknown .... *A. abnormicornis*, sp. n.

All coxæ pale.
Legs wholly brownish yellow; antennæ in male subclavate, the joints transverse; female unknown .... *A. pallidipes*, sp. n.
2. Wholly brownish yellow.
Club of stigmal vein very large, circular; dorsum of metanotum black; antennæ in female subclavate, brown; male unknown .... *A. megastigma*, sp. n.
Yellowish white, with brownish and black markings; the club of the stigmal vein normal.
Middle lobe of mesonotum, the scutellum and axillæ, except margins, and the metanotum black; occiput and vertex, except orbits and a streak before and behind the ocelli, pronotum anteriorly and three or four fasciæ above, disks of abdominal segments, and venter brown; the 3rd abdominal segment with a whitish fascia along the sides curving upwards and extending along the apical margin .... *A. pulchra*, sp. n.

ASHMEADIA INSULARIS, sp. n.

♀. Length 3 millim. Robust, black, shagreened; scape and legs, except coxæ and the femora at base, brownish yellow; flagellum subclavate, brown-black, the joints transverse; suture and margins between abdominal segments 5 and 6 piceous; scutellum with some shallow umbilicate punctures; metathorax rugose. Wings hyaline, the venation yellowish, the marginal vein very long, about two thirds the length of the submarginal, or three or more times longer than the stigmal. Abdomen subpetiolate, conic-ovate, a little longer than the head and thorax united, shagreened.

The male is only 2 millim. long and, except in its smaller size, a more flattened, petiolate abdomen (the petiole short and stout), and pale brown antennæ, it agrees in all respects with the female.

Hab. St. Vincent.

Described from one male and one female.

ASHMEADIA PALLIDIPES, sp. n.

♂. Length 1·8 millim. Agrees well with the male of *A. insu-*

laris, except the legs, including all coxæ, are uniformly brownish yellow, the scutellum exhibits no umbilicate punctures, the petiole of abdomen is more slender and longer, being about $2\frac{1}{2}$ times as long as thick, while the venter is piceous.

Hab. St. Vincent.

Described from one male specimen.

Ashmeadia abnormicornis, sp. n.

♂. Length 1·5 millim. Wholly black, except the articulations of legs and the tarsi, which are honey-yellow. Antennæ with the funicle-joints round and strongly pedicellated at apex, with whorls of whitish hairs, the club being 3-jointed. Wings clear hyaline, the marginal vein long and slender, more than three times the length of the stigmal vein.

Hab. St. Vincent.

Described from a single specimen.

The peculiarity of the antennæ renders the species easy of recognition, and will probably warrant, when the female is discovered, the creation of a new genus for its reception.

Ashmeadia megastigma, sp. n.

♀. Length 2 millim. Wholly brownish yellow, the metanotum and sheaths of ovipositor black; flagellum pale brownish, the joints transverse, pubescent; wings hyaline, the stigmal vein terminating in a large circular stigma, the marginal vein less than three times the length of the stigmal.

Hab. St. Vincent.

Described from one specimen.

The large, circular stigma, as in the Torymid genus *Megastigma*, at once distinguishes the species.

Ashmeadia pulchra, sp. n.

♂ ♀. Length 1·5 to 2 millim. Yellowish white; vertex of head and the occiput, except a spot before and behind ocelli and the orbits, the pronotum anteriorly and three or four fasciæ on its disk, abdominal segments above, and the venter brownish; middle lobe of mesonotum, scutellum and axillæ, except margins, and the metanotum black; the third abdominal segment has a long white fascia at sides that curves upwards and extends along the apical margin of the segment; scape of antennæ white; flagellum subclavate, brown, the joints transverse. Wings

hyaline, the venation pale, the marginal vein three times as long as the stigmal.

The male is the smaller, and differs only in having the abdomen less pointed, and with the sides, apex, and the venter wholly white.

Hab. St. Vincent.

Described from 15 female and 4 male specimens.

This is the prettiest species yet discovered in the genus, and resembles somewhat a pale species, undescribed, known to me from South Florida.

SYSTOLE, *Walker*.

(?) SYSTOLE ABNORMIS, sp. n.

♀. Length 1·6 millim. Black, smooth, impunctate, sparsely covered with whitish pubescence, or the head and thorax at the most feebly shagreened. Abdomen conic-ovate, highly polished, the fifth segment very long. Antennæ subclavate, sparsely pubescent, the pedicel much larger than the first funicle-joint, the funicle-joints a little longer than wide. Wings hyaline, the venation pale yellowish, the marginal vein very long, three times as long as the stigmal. Antennæ and legs, including coxæ, pale yellowish, pubescent.

Hab. St. Vincent.

Described from three female specimens. The venation and the relative length of the abdominal segments will exclude this species from *Systole*, although otherwise, in sculpture and in antennal characters, it agrees with the definition of the genus. It agrees in venation with *Ashmeadia*, but otherwise its habitus is wholly different.

BEPHRATA, *Cameron*.

BEPHRATA CULTRIFORMIS, sp. n.

♀. Length 5 millim. Brownish yellow or yellowish, except as follows:—flagellum, stemmaticum, median stripe on pronotum, middle lobe of mesonotum, and rest of thorax, except axillæ and parapsides, black; hind tibiæ, large spots on the dorsum of abdominal segments extending into a triangular shape at the sides, and the terminal segment black. The antennæ are filiform, the joints elongate, cylindrical, the first funicle-joint as long as the scape. The head is much broader than the thorax. Wings greyish hyaline, the venation brown-black; the marginal vein is

nearly twice as long as the stigmal; while the abdomen is strongly compressed, knife-shaped, as in the Cynipid genus *Ibalia*, and almost two and a half times as long as the head and thorax combined.

Hab. St. Vincent.

Described from a single specimen. The species is remarkable for the cultriform abdomen.

DECATOMIDEA, *Ashmead.*

DECATOMIDEA PALLIDICORNIS, sp. n.

♀. Length 2·1 millim. Black, strongly confluently punctate, with a whitish pubescence; antennæ, tegulæ, and legs, except coxæ, pale brownish yellow; the coxæ black, scaly punctate, pubescent; posterior tibiæ with stiff bristles behind; funicle-joints a little longer than wide, the first the longest joint; pedicel brownish above, parapsidal furrows indicated only anteriorly, obliterated posteriorly; pleura striate. Wings clear hyaline, the venation pallid or whitish, the marginal vein about one and a half times as long as the stigmal, while the postmarginal is only a little longer than the stigmal. Abdomen subglobose, with a reticulate or scaly punctuation at sides and beneath, almost smooth along the dorsum, the petiole very short; the 4th segment the longest, three times as long as the 3rd segment above.

The male agrees with the female except in having the flagellum black, the joints being bearded with long hairs, the first funicle-joint longer than half the length of the scape and stouter than any of the following, the funicle-joints 2, 3, and 4 being contracted at tips. Mandibles and palpi pale, the outer margin of mandibles being brown.

Hab. St. Vincent.

Described from one male and one female.

EURYTOMA, *Illiger.*

Table of Species.

Species more or less brownish yellow .... 2.
Species black.
  Coxæ pale.
    Scape and legs pale brownish yellow; venter
      piceous (♀) .... *E. insularis*, sp. n.
  Coxæ black.
    Scape and legs pale brownish yellow.
      Funicle-joints 1 to 5 long and strongly

pedicellate at apex, each joint bearing two whorls of whitish hairs; no pale spot on pronotum; tegulæ pale; petiole one half longer than hind coxæ, closely punctate. (♂)...... *E. insularis*, sp. n.

Hind femora, except at tips, black.

Funicle-joints 1 to 5 pedicellate, with two whorls of long hairs; a yellow spot at the anterior angle of pronotum; tegulæ black; petiole longer than hind coxæ, smooth towards apex and along the sides. (♂) .... *E. peraffinis*, sp. n.

2. Brownish yellow.

Median stripe on pronotum, middle lobe of mesonotum and metanotum, except the angles, dusky or black.

Petiole in both sexes long, slender, black; body of abdomen above with black markings; 3rd ventral segment with a black spot.

♀. Flagellum black, the joints twice as long as thick .... *E. maculiventris*, sp. n.

♂. Antennæ wholly black, except sometimes the scape at base or beneath; funicle-joints much elongated, pedicellate at apex, with two distinct widely separated whorls of long hairs, the first joint being nearly as long as the scape .... *E. maculiventris.*

Eurytoma insularis, sp. n.

♂ ♀. Length from 2 to 3 millim. Black, umbilicate-punctate, with a sparse glittering white pubescence. In the female the scape, tegulæ, and legs, including coxæ, are wholly pale brownish yellow; venter piceous or rufous; the pedicel and flagellum brown-black; first funicle-joint one half longer than the second, the joints beyond gradually subequal, the last being not, or scarcely, longer than wide; club 3-jointed. Wings hyaline, the venation pallid yellow, the marginal vein being about one and a half times as long as the stigmal, the postmarginal scarcely longer than the stigmal. Abdomen conic-ovate, not quite as long as the thorax, with a very short rugose petiole, the rest of abdomen being smooth and highly polished, the 5th segment

three times as long as the 4th, the following with sparse white hairs.

The male agrees with the female, except in having the coxæ black; flagellum very long, black, the funicle-joints 1 to 5 strongly pedicellate at apex, with two whorls of long white hairs, the first joint being the longest, fully two thirds the length of the scape; joints 8 and 9 separated by a constriction; petiole long, one half longer than the hind coxæ, uniformly and confluently punctate; body of abdomen smooth, polished, the third segment (excluding the petiole) the longest, fully twice as long as the second, the first longer than the second, with a large fovea at base above.

Hab. St. Vincent.

Described from 1 female and 8 male specimens.

EURYTOMA PERAFFINIS, sp. n.

♂. Length 2·5 millim. Closely allied to *E. insularis*, but differs as follows:—The scape is pale only at base beneath; the pronotum has a yellow spot at the angles anteriorly, and easily overlooked if the head is thrown back on the collar; hind femora, except at tips, black; petiole much longer than the hind coxæ, smooth towards apex and along the sides, finely punctate towards base; while the third body-segment of the abdomen is more than twice as long as the second.

A female specimen of what is undoubtedly the opposite sex of this species, *without a head*, agrees in all essential characters with the male, except that all the femora toward base are more or less dusky or black; as in the male, it shows a pale spot on the angles of the pronotum anteriorly; the abdomen is shaped much as in the female *insularis*, only it is black, except just at base beneath, and shows a very delicate wavy lined sculpture along the sides under a strong lens.

Hab. St. Vincent.

Described from one male and one female.

Distinguished by the pronotal spot, more frequently met with in the genus *Isosoma*.

EURYTOMA MACULIVENTRIS, sp. n.

♂ ♀. Length 2·5 to 3 millim. Brownish yellow; teeth of mandibles 4-dentate; flagellum, stemmaticum (especially in the male), median stripe on collar, middle lobe of mesonotum, meta-

notum (except a large spot at posterior angles and the pleura), the petiole, markings on disks of abdominal segments 2, 3, 4, and 5, and the base of ventral segment 2, black or dusky. Wings hyaline, the venation pallid, the marginal vein about twice as long as the stigmal. Antennæ in female filiform, the funicle-joints about twice as long as thick, the first the longest; hind tibiæ with stiff bristles behind. Abdomen conic-ovate, compressed, pointed at apex, the petiole as long as the hind coxæ, the fourth body-segment two and a half times as long as the third.

In the male the antennæ are wholly black, except the scape at base or beneath, the funicle-joints all elongated, pedicellate at apex, with two whorls of widely separated long hairs, the first joint being as long as the scape; abdomen ovate, compressed, the petiole long, slender, the third and fourth body-segments nearly of an equal length; spiracles of the sixth segment surrounded by black.

Hab. St. Vincent.

Described from 4 female and 3 male specimens.

CHRYSIDEA, *Spinola.*

This genus seems to differ from *Eurytoma* only in its strongly metallic colour, and unless structural characters are discovered to separate the two, it cannot be accepted as a valid genus.

The genus seems peculiar to the South-American fauna, but a single male specimen being in the collection from St. Vincent. The genus is placed in the family Perilampidæ by Westwood and Spinola.

CHRYSIDEA AURATA, sp. n.

♂. Length 2 millim. Head, thorax, and coxæ golden green, strongly coarsely confluently punctate; scape at base and legs, except the coxæ and hind femora, brownish yellow; rest of antennæ, hind femora, except tips, and the abdomen black, the latter with an æneous tinge at the sides of the 4th segment. Antennæ very long, the funicle-joints all lengthened, pedicellate at apex, and with 2 whorls of long white hairs, each joint being also slightly constricted at the middle between the whorled hairs, the first joint being almost as long as the scape. Wings hyaline, the venation pale brownish yellow, the marginal vein about twice the length of the stigmal. Abdomen with a long petiole, which is thicker at base than at apex; body of abdomen pear-shaped, the

first segment more than twice the length of the second, the third fully four times as long as the second, while the following are very short, slightly withdrawn within the third.

Hab. St. Vincent.

Described from a single male specimen.

Eurytomocharis, *Ashmead.*

Eurytomocharis minima, sp. n.

♂ ♀. Length 1·6 millim. Black, umbilicate-punctate, with a sparse whitish pubescence; antennæ and legs, except coxæ, reddish yellow, the hind tibiæ behind with several long bristle-like spines. Eyes large, almost circular. Pedicel stouter and longer than the first funicle-joint, the scape being as long as the pedicel and first two funicle-joints combined; flagellum sub-clavate, the funicle-joints oblong-oval, the club fusiform, 3-jointed, much stouter than the funicle. Wings hyaline, the venation pale yellowish, the marginal vein nearly twice the length of the stigmal, the latter curving upwards, the postmarginal very little longer than the stigmal. Abdomen conic-ovate, produced into a conic point at apex, nearly sessile, with an alutaceous punctuation at the sides, the 2nd segment (1st body-segment) being a little longer than either the 3rd or 4th, which are about equal, the 5th longer than all the preceding united.

The male differs from the female only in its antennal and abdominal characters:—The antennæ (excluding ring-joints) are 8-jointed, the four funicle-joints nearly of an equal length, strongly pedicellate at apex, with long bristly hairs, the scape being no longer than the pedicel and first funicle-joint united; the body of abdomen is globose, with the 3rd segment the longest, it being as long as the 1st and 2nd united, and encloses the following; while the petiole is almost as long as the body of the abdomen, shining, and almost smooth. In this sex the hind femora have a dusky or black cloud toward the apex.

Hab. St. Vincent.

Described from two female and two male specimens.

Isosoma, *Walker.*

Isosoma heteromera, sp. n.

♂ ♀. Length 3 to 4 millim. Black, the head and thorax umbilicate-punctate, with a sparse white pubescence; scape and legs, except hind coxæ, reddish yellow; flagellum brownish,

pubescent; the first funicle-joint is the longest, the following joints being gradually subequal, the last scarcely longer than wide, while all are rounded at base and apex; club 3-jointed. Wings hyaline, the tegulæ small, yellowish, the venation pallid, the marginal vein about one and a half times as long as the stigmal. Abdomen elongate conic, highly polished, pubescent at apex, as long as the head and thorax combined; the segments unequal in length, the 1st and 3rd body-segments almost equal, the 2nd slightly shorter, the 4th as long as all the preceding united, the 5th a little shorter than the 3rd, the 6th one half longer than the 5th.

The male differs from the female as follows:—The funicle-joints are strongly pedicellate at apex, verticilately pilose, the scape being scarcely as long as the small pedicel and first funicle-joint united; body of abdomen ovate, subcompressed, the 3rd segment being a little longer than 1 and 2 united, 4 and 5 subequal, the 5th the longer.

Hab. St. Vincent.

Described from two females and one male.

Subfamily Torymınæ.

Callyostichus, *Mayr*.

Callyostichus auratus, sp. n.

♂. Length 1·8 millim. Golden-green, shagreened, and with a few scattered punctures over the surface, sparsely pubescent; antennæ and legs pale brownish yellow. Abdomen broadly oval, much depressed or very flat, pale yellowish, except a dusky spot at base and apex, the segments nearly of an equal length, the first segment foveated at base by the short thick petiole. Antennæ inserted a little below the middle of the face, the scape rather short, not reaching to the ocelli, the pedicel large, stout; funicle-joints increasing in width toward the club, the joints transverse. Thorax rather long; the pronotum large, trapezoidal, longer than the mesonotum; mesonotum with two distinct furrows; scutellum longer than wide, convex behind; axillæ separated, convex; metathorax subquadrate, with a median carina, the metapleura prominent, convex. Wings hyaline, pubescent, the tegulæ and venation pale, the marginal vein a little more than twice the length of the stigmal, the latter clavate, oblique, about two thirds the length of the postmarginal.

Anterior and posterior legs longer and stouter than the middle legs, their femora a little dilated.

Hab. St. Vincent.

Described from a single specimen.

Lochites, *Förster*.

Lochites auriceps, sp. n.

♀. Length 1·8 to 2 millim.; ovipositor as long as the body. Brownish yellow; the head wholly golden green; metanotum and a spot at base of middle coxæ æneous; abdomen with two or three brownish bands, usually interrupted; ovipositor black; flagellum brown-black, with two ring-joints, the funicle-joints a little wider than long. Head sparsely punctate; the thorax feebly punctate, with distinct parapsidal furrows. Wings hyaline, tegulæ pale; venation brownish, the stigmal vein short, curved at tip.

♂. Length 1·5 millim. Golden green; scape, prothorax beneath, legs, including coxæ, and abdomen, except a large spot on dorsum towards apex, yellowish white.

Hab. St. Vincent.

Described from 12 specimens.

Torymus, *Dalman*.

Torymus rugosipunctatus, sp. n.

♂ ♀. Length 1 to 2 millim. Subrobust; gold-green to bronze-green, more rarely blue-green, with coarse umbilicate punctures; antennæ dark brown, the scape paler beneath; legs with trochanters, tips of femora, the tibiæ, and tarsi brownish yellow, the hind tibiæ usually dusky at the middle; coxæ and femora, except tips, bronzed or metallic. Mesonotum not longer than wide, the furrows distinct; collar short. Wings hyaline, the tegulæ and venation pallid or whitish, the marginal vein as long as the submarginal, the stigmal very minute, sessile, scarcely half the length of the postmarginal. Flagellum subclavate, the joints transverse. Ovipositor a little longer than the body, black, with a yellow tip.

Hab. St. Vincent.

Described from 8 male and 12 female specimens.

Torymus pallidipes, sp. n.

♀. Length 2 millim. Slender; head and thorax metallic green, shagreened; abdomen blue-green, smooth; scape and

legs, except hind coxæ, pale yellowish; flagellum dark brown, the first joint the longest, the following a little longer than thick. Collar triangular; mesonotum longer than wide, with distinct furrows; scutellum about twice as long as wide, the axillæ large, projecting slightly forward into the parapsidal field; metathorax smooth, the spiracles rather large, oval. Wings hyaline, the tegulæ and venation yellowish, the marginal vein nearly as long as the submarginal, the stigmal vein very minute.

Hab. St. Vincent.

Described from two specimens.

SYNTOMASPIS, *Förster*.

SYNTOMASPIS PUNCTIFRONS, sp. n.

♂. Length 2 millim. Bronze-green, shagreened, and sparsely covered with a whitish pile; face with rather coarse punctures and a median carina below the insertion of antennæ; scape, knees, tibiæ, and tarsi reddish yellow; flagellum brown-black, the joints about one and a half times as long as thick. Collar triangular; mesonotum a little longer than wide, with distinct furrows; scutellum with a cross furrow at two-thirds its length. Wings hyaline, the venation whitish, the marginal vein almost as long as the submarginal, stigmal very minute.

Hab. St. Vincent.

Described from one male specimen.

Subfamily TRIDYMINÆ.

TRIDYMUS, *Ratzeburg*.

TRIDYMUS SOLITARIUS, sp. n.

♂. Length 1·4 millim. Bronze-green, feebly minutely punctate or almost smooth; face bluish; cheeks beneath the eye metallic green; abdomen towards apex blue-black; basally yellow, the yellow beneath more apparent and occupying half the length of the venter; antennæ and legs honey-yellow, the former obfuscated towards tips; coxæ greenish or bluish green basally; flagellum moniliform, pilose, the joints a little transverse. Mesothorax trilobed, the lobes convex, the lateral much shorter than the middle lobe; collar distinct, triangular; axillæ bluish; scutellum bronze-green, strongly contrasting with the colour of the axillæ, and with a transverse line before its apex. Wings hyaline, pubescent, the venation brown, the marginal

vein once and a half as long as the stigmal, the latter ending in a rather large circular stigma.

Hab. St. Vincent.

Described from a single specimen.

Subfamily PTEROMALINÆ.

Tribe CHIROPACHIDES.

ACROCORMUS, *Förster.*

ACROCORMUS MEGASTIGMUS, sp. n.

♂. Length 2·1 millim. Dull metallic green, confluently punctate; pleura, hind femora, and abdomen æneous black, smooth, shining; scape and legs, except coxæ, brownish yellow, anterior and middle femora and posterior tibiæ dusky. Flagellum cylindrical, pilose; the first funicle-joint the longest, almost as long as the scape, the following joints gradually subequal. Pronotum longer than its width at base, narrowed into a neck anteriorly. Mesonotal furrows delicate but complete, the lateral lobes short, the middle lobe twice as long as wide. The axillæ extend forward into the field of the parapsides to a line with the tegulæ. Scutellum with a straight impressed line at the sides. Metathorax with a median carina. Wings hyaline, ciliate, with a dusky substigmal band, extending to the middle of the wing, and a small dusky spot at the middle below the base of the marginal vein; marginal vein slender and long, about as long as the submarginal vein; stigmal vein short and terminating in a large oblong stigma that runs parallel with the postmarginal. Anterior femora not thicker than the hind femora; posterior tibiæ with two apical spurs.

Hab. St. Vincent.

Described from one specimen. The large stigma, resembling that found in the genus *Dinotus*, at once distinguishes the species.

Tribe SPHEGIGASTRIDES.

CYRTOGASTER, *Walker.*

CYRTOGASTER VULGARIS, *Walk. Ent. Mag.* i. p. 382.

Hab. St. Vincent, Europe, United States.

Four specimens of what is evidently this European species are in the collection. It is very variable in colour, from æneous black to metallic bronze and green, the legs from orange-yellow to fuscous and black, the female always having the paler-coloured

legs. The habits of the genus in Europe seem not to be known, in Florida I have reared a species from an *Aphis*, and its habits are therefore identical with *Pachyneuron*.

Tribe Diparides.

Lelaps, *Haliday*.

Of this interesting genus two distinct species occur in St. Vincent, distinguished as follows:—

Greenish æneous or æneous black; pleura, metathorax, and abdomen black.
- ♀. Pedicel, middle of funicle, club, and legs luteous; wings with a longitudinal fuscous band extending to the stigmal vein, and between this and the apex of the wing is a large fuscous spot.
- ♂. Flagellum long, black, pilose; wings wholly hyaline .... *L. pulchricornis*, Hal.

Brownish yellow.
- ♀. Antennæ, except 2 to 4 apical joints of funicle and the basal joint of club which are black, honey-yellow; wings yellowish hyaline, with a spot beneath the base of marginal vein, another smaller spot enclosing the stigmal vein, and the apex of wing fuscous; between the stigmal vein and the apical fuscous part are two large oblique whitish spots that meet and form a band.
- ♂. Flagellum and abdomen black, the former pilose; wings clear hyaline .... *L. flavescens*, sp. n.

Lelaps pulchricornis, *Hal. Ann. & Mag. N. H.* xii. p. 47, ♀.

Hab. St. Vincent.

Of this species there are sixteen male and eleven female specimens in the collection. The male was unknown to Haliday and Walker, and agrees with the female, except as follows:—The antennæ are long, filiform, the flagellum being wholly black, the joints all long, cylindrical, pilose; wings clear hyaline; while the abdomen is longly petiolated, the body pear-shaped.

Lelaps flavescens, sp. n.

♀. Length 2 to 2·2 millim. Brownish yellow or yellow, with coarse sparse black bristly hairs; antennæ, except the three or four apical joints of funicle and the basal joint of club which are

black, and the legs pale yellowish or luteous, the coxæ, tibiæ, and tarsi usually white. Wings yellowish hyaline, with a spot beneath the origin of marginal vein, another smaller spot enclosing the stigmal vein, and the apex of wing dusky or black; between the stigmal vein and the smoky apical portion are two large oblong oblique whitish spots that meet and form a transverse band. Abdomen subpetiolate, conic-ovate, produced into a stylus at apex.

The male is only 1·5 millim. long, with a black pilose flagellum, the joints of which are long and cylindrical; abdomen pear-shaped, black, with a long slender petiole; while the wings are clear hyaline.

Hab. St. Vincent.

Described from two male and three female specimens.

Tribe Pteromalides.

Hemitrichus, *Thomson.*

Hemitrichus varipes, sp. n.

♂. Length 1·1 millim. Black to blue-black, rarely with an æneous tinge, the face below antennæ most frequently metallic green, the surface smooth, impunctured. Scutellum nearly twice as long as wide, convex, with an impressed cross-line just before its apex. Head transverse, wider than the thorax, the vertex broad with the ocelli subtriangularly arranged, the frons with an antennal impression. Antennæ inserted just above the mouth, the joints oblong-oval, constricted at apices, with sparse whorls of long hairs. Thorax short, the pronotum not visible from above, the parapsidal furrows distinct anteriorly, subobsolete posteriorly; axillæ small, convex; metathorax very short, smooth, usually with a brassy tinge. Wings hyaline, the tegulæ black, the venation brown, the marginal vein long, nearly as long as the submarginal, or three times as long as the stigmal, the latter ending in an oblong stigma with a small uncus, the postmarginal a little longer than the stigmal. Legs brownish or honey-yellow, the coxæ always black, the femora variable, rarely entirely pale, more frequently dusky or black, the hind tibiæ sometimes dusky at the middle. Abdomen oval or oblong, black, rarely with an æneous tinge at base; the second segment the longest, foveated at base.

Hab. St. Vincent.

Described from six male specimens.

PICROSCYTUS, *Thomson*.

PICROSCYTUS NIGROCYANEUS, sp. n.

♀. Length 1·1 millim. Blue-black, shagreened; scape pale; flagellum clavate, brown-black, pubescent; trochanters, knees, tips of tibiæ and tarsi yellowish white. Head transverse, the occiput concave, the vertex rather sharp with the frons impressed. Antennæ inserted just above the clypeus; the flagellum filiform, with the joints a little longer than thick, the first shorter than the second; club 3-jointed, fusiform, much stouter than the funicle. Thorax subovoid, the collar distinct but short, transverse, the parapsidal furrows indicated only anteriorly; the scutellum longer than wide, with a straight impressed line at the sides; metathorax very short. Wings and venation hyaline, or the latter pallid yellowish; tegulæ yellow; the marginal vein long, only a little shorter than the submarginal, the postmarginal no longer than the stigmal. Abdomen acute-ovate, produced into a point at apex, the venter carinate or boat-shaped.

Hab. St. Vincent.

Described from a single specimen.

ROPTROCERUS, *Ratzeburg*.

ROPTROCERUS AURATUS, sp. n.

♀. Length 2 millim. Golden green, confluently punctate, the pleura blue-green; scape, pedicel and legs, including coxæ, orange-yellow. Head transverse, a little wider than the thorax, the vertex convex, the face with a slight antennal furrow. Antennæ inserted on the middle of the face, the scape cylindrical, extending to the ocelli; flagellum broken off at the pedicel. Pronotum distinct from above, a little dilated at the angles; parapsidal furrows entire, strongly converging toward the scutellum, the middle lobe anteriorly fully as wide as long, posteriorly scarcely one third as wide as anteriorly; axillæ distinctly separated, triangular, separated from the parapsides by a transverse grooved line on a line with the groove at base of scutellum, therefore not produced into the field of the parapsides; sides of scutellum oblique. Wings hyaline; the tegulæ and venation yellow, the marginal vein scarcely longer than the stigmal, the latter long, oblique, ending in a small stigma, the postmarginal vein slender, but as long as the marginal. Abdomen subsessile, conic-ovate, one third longer than head and thorax united, metallic green, with prominent black ovipositor; segments 2, 4,

and 5 about equal, segment 3 the longest. Hind coxæ long, conical.

Hab. St. Vincent.

Described from a single specimen.

SPINTHERUS, *Thomson.*

(?) SPINTHERUS DUBIUS, sp. n.

♀. Length 2·6 millim. Blue-green, confluently punctate, the metanotum metallic green; scape and legs pale yellowish; coxæ blue-black, the femora toward base with a bluish or dusky blotch. Flagellum subfiliform; the funicle-joints, except the last, about twice as long as thick, the first longer than the pedicel, the last quadrate; club 3-jointed. Head transverse, the cheeks convex. Thorax three times as long as wide, the collar distinct, narrowed anteriorly, the axillæ conjoined to the parapsides; scutellum not longer than wide, convex posteriorly; metathorax with delicate median and lateral keels or folds, the spiracles close to the metathoracic band, oval. Wings hyaline, the tegulæ and venation pale yellowish, the marginal vein long, two thirds the length of the submarginal, the stigmal vein oblique and less than half the length of the marginal, with a small stigma, the post-marginal vein nearly twice as long as the stigmal. Abdomen conic-ovate, a little longer than the head and thorax combined; the segments, except the first body-segment, about of an equal length.

Hab. St. Vincent.

Described from three female specimens.

This species is doubtfully placed in the genus *Spintherus*, as the teeth of the mandibles could not be counted, the mandibles being closed and partly hidden by the clypeus.

MERAPORUS, *Walker.*

MERAPORUS NIGROCYANEUS, sp. n.

♂. Length 1·1 millim. Blue-black, shagreened, the mesonotum with a slight æneous tinge; scape, trochanters, tibiæ except a cloud at the middle, and tarsi yellowish white; flagellum brown-black, subclavate, pilose, the pedicel one third longer than the first funicle-joint and stouter; funicle-joints after the first a little longer than thick, very gradually widened towards club; club stouter, 3-jointed. Head transverse, wider than thorax, the face with a slight antennal impression. Thorax twice as long

as wide, the collar very short, the parapsidal furrows indicated anteriorly, convergent; axillæ small, indistinctly separated from the parapsides. Wings hyaline, tegulæ and venation pale brownish, the marginal vein one and a half times as long as the stigmal. Abdomen ovate, depressed, with a large whitish blotch at basal half.

Hab. St. Vincent.

Described from a single specimen.

CHRYSOGLYPHE, gen. nov.

Allied to *Glyphe*, Walker, but with the following differences:—Head very wide, with the eyes nearly twice as wide as the thorax, the vertex very broad, the ocelli subtriangularly arranged and rather close together, the laterals being only one and a half times their diameter from the front ocellus, but full three or four times their diameter from the border of the eye. Eyes very large, occupying nearly the whole side of the head, and leaving only a short space between them and the mandibles. Both mandibles 4-dentate. Antennæ 13-jointed, filiform, pilose, the pedicel a little shorter than the first funicle-joint; ring-joints 2, minute; funicle 6-jointed, the joints a little less than twice as long as thick; club 3-jointed. Thorax ovate; pronotum visible from above only as a slight transverse line, but in reality it is triangular, the triangular portion being usually hidden in the occiput of the large broad head; mesonotum about twice as wide as long, with only slight indications of parapsidal furrows anteriorly; axillæ large and projecting obliquely forward into the field of the parapsides a little beyond the base of scutellum; metathorax short, but with a prominent punctate neck, as in *Pteromalus*, to which the abdomen is attached, the petiole being exceedingly short; spiracles oval, close to the metathoracic band, and with a sulcus. Wings pubescent, the marginal vein long, fully two thirds as long as the submarginal, or twice or more than twice as long as the stigmal, the latter clavate, very slightly curved; postmarginal almost twice as long as the stigmal. Abdomen conic-ovate, the venter towards base usually acutely triangularly carinated, the first body-segment the longest, as long as 2, 3, and 4 combined, these about equal, 5th a little longer than 4th, 6th almost as long as the basal segment, 7th conic, a little shorter than the 6th; sheaths of ovipositor slightly prominent.

The male has the antennæ subclavate, pilose, the first funicle-joint being only half as long as the second; or it is long, filiform, with all the funicle-joints long, cylindrical, and pilose; the marginal and postmarginal veins are slightly shorter than in the female, while the abdomen is clavate, with a pale spot towards the base.

Two species in this genus can be tabulated as follows:—

Females.

Golden green, scaly-punctate; legs white or pale yellowish.
- Club of antennæ yellowish white; abdomen acutely produced at apex, the basal one-third whitish. *C. apicalis*, sp. n.
- Club of antennæ not yellowish white; abdomen cupreous, with no white spot at base .... *C. albipes*, sp. n.

Males.

- Flagellum black, long, filiform, pilose, the funicle-joints from three to four times as long as thick; abdomen with a pale spot at base .... *C. apicalis.*
- Flagellum brown-black, shorter, subclavate, pilose, the funicle-joints only once and a half as long as thick; abdomen cupreous at base, rarely with a minute pale spot .... *C. albipes.*

CHRYSOGLYPHE APICALIS, sp. n.

♀. Length 2 to 2·2 millim. Golden green, scaly-punctate; scape, pedicel, and club of antennæ and legs yellowish white; funicle brown-black; venter and basal one-third of abdomen white or pale yellowish; mandibles brownish yellow, 4-dentate. Head very broad, nearly twice the width of thorax, the occiput concave, the frons with a slight antennal furrow. Antennæ 13-jointed, the funicle-joints subequal, the first the longest, one third longer than the pedicel, the last scarcely longer than wide. Wings hyaline, pubescent, tegulæ yellowish, venation pale; the marginal vein long, almost as long as the submarginal, the postmarginal a little shorter, the stigmal oblique, half the length of the postmarginal. Legs white, the posterior coxæ sometimes with a dark spot at base outwardly. Abdomen conic-ovate, produced into a point at apex, the ovipositor-sheaths slightly projecting; venter at middle triangularly produced; venter and basal one-third of dorsum pale or yellowish, rest of abdomen metallic brown or greenish.

♂. Length 1·1 millim. Head purplish; thorax metallic gold-green; scape, pedicel, legs, and base of abdomen pale yellowish or white; flagellum very long, filiform, pilose, black; the funicle-joints all long, from three to four times as long as thick; abdomen clavate, otherwise as in the female.

Hab. St. Vincent.

Described from one male and two female specimens.

CHRYSOGLYPHE ALBIPES, sp. n.

♀. Length 1·8 millim. Golden green, scaly-punctate; scape, pedicel, tegulæ, and legs white, the coxæ with a greenish spot at base; flagellum brown, pubescent, the funicle-joints a little longer than thick; abdomen conic-ovate, metallic or cupreous, except along the venter, the latter triangularly carinated at the middle, white. Wings hyaline, pubescent, the venation pale; the marginal vein two thirds the length of the submarginal, the stigmal a little longer than half the length of the postmarginal.

♂. Length 1·1 millim. Differs from the female only as follows:—Flagellum subclavate, pilose, the pedicel larger than the first funicle-joint, the latter smaller than the following joints; legs white, with the hind coxæ metallic and the anterior and middle coxæ with a spot at base; while the abdomen is clavate, metallic, rarely showing a slight pale spot at base.

Hab. St. Vincent.

Described from one female and two male specimens.

GLYPHE, *Walker*.

GLYPHE PUNCTATA, sp. n.

♀. Length 2 millim. Blue-black, moderately confluently punctate, the head and disk of thorax with a faint æneous or metallic tinge; scape, trochanters, tips of femora, and the tibiæ and the tarsi honey or brownish yellow; flagellum brown, subclavate, the funicle-joints longer than thick, club a little thicker than the funicle, 3-jointed. Head very little wider than the thorax. Left mandible 4-dentate. Thorax subovoid, the collar exceedingly short, visible from above as a transverse line; mesonotum wider than long, with the parapsidal furrows indicated only anteriorly; metathorax very short. Wings hyaline, the tegulæ and venation pale brownish, the marginal vein long, nearly as long as the submarginal, postmarginal less than half the length of marginal, or one half longer than the stigmal, the latter clavate. Abdomen elongate, compressed, longer than the

head and thorax together, the base beneath produced forward into a compressed triangular process that extends to the middle coxæ; hypopygial valves prominent, ploughshare-shaped.

Hab. St. Vincent.

Described from two female specimens.

Catolaccus, *Thomson*.

Table of Species.

Bright golden green, without scattered white hairs.	
Legs orange-yellow to yellowish white, the femora with a small dusky cloud toward base; abdomen pointed ovate, longer than head and thorax combined, metallic green. ♀.	
♂ with the venter and a spot on dorsum near the base whitish	*C. pallipes*, sp. n.
Bronze-green to æneous black or bluish green, rarely bright green.	
Species with scattered white hairs.	
Legs honey-yellow or pallid; the coxæ and femora, except tips, metallic.	
♀ abdomen pointed ovate, much longer than the head and thorax together.	
♂ abdomen ovate, not longer than the thorax, with a large white spot at base.	*C. vulgaris*, sp. n.
Species bare, without the scattered white hairs.	
Legs, except coxæ, pallid or whitish; abdomen pointed ovate, longer than head and thorax united. ♀	(?) *C. helice*, Walk.

Catolaccus pallipes, sp. n.

♀. Length 2·5 millim. Bright golden green, confluently punctate, without the scattered white hairs; scape and legs orange-yellow or yellowish white, the coxæ, except at tips, usually metallic, the femora dusky toward base; flagellum brown. Funicle 6-jointed, the first joint twice as long as thick, the following very gradually subequal and slightly widened, the last being a little wider than long; club fusiform, 3-jointed, a little wider than the last funicle-joint. Collar short, transverse, as wide as the mesonotum. Mesonotum wider than long, with the parapsidal furrows distinct anteriorly for two thirds its length, converging behind. Scutellum transversely divided by an impressed line before its tip. Wings hyaline, the tegulæ and venation pallid or yellowish; marginal vein about half the length

of the submarginal, or less than twice the length of the stigmal, the latter clavate; postmarginal very slightly shorter than the marginal. Abdomen pointed ovate, longer than the head and thorax combined, subsessile, metallic green; the first body-segment the longest, as long as segments 2, 3, and 4 combined, with a large fovea at base surrounding the very short petiole; segments 5 and 6 subequal, longer than the 4th.

♂. Length 2 millim. Differs from female only in its ovate abdomen, with the venter and spot on dorsum white.

Hab. St. Vincent.

Described from one male and one female.

Catolaccus vulgaris, sp. n.

♂ ♀. Length 1 to 3·1 millim. In colour variable from a bronze-green to blue-green or æneous; head and thorax confluently punctate, with short, sparse, white hairs; scape and legs honey-yellow or brownish yellow, often whitish, but with the coxæ and femora, except at tips, always metallic, bronze, or æneous. Funicle 6-jointed, filiform, the first joint a little the longest, the last longer than wide; club slightly stouter, 3-jointed. Thorax as in the preceding species, only the parapsidal furrows are only distinct for half the length of the mesonotum anteriorly, and the scutellum is without the transverse impressed line before its apex. Wings hyaline, the tegulæ and venation yellowish; marginal vein two thirds the length of the submarginal, or about two and a half times as long as the stigmal, the postmarginal about two thirds the length of the marginal. Abdomen pointed, ovate, subsessile, from one third to one half the length of the head and thorax united.

The male differs from the female decidedly in its antennal and abdominal characters. The antennæ are subfiliform, pubescent, the flagellum much stouter than the scape and pedicel, the funicle-joints very gradually subequal, almost twice as long as thick, the first joint being twice as long as the pedicel; abdomen ovate, not quite as long as the thorax, the basal half, except at junction with the metathorax, white, or at least with a large white blotch both above and beneath, the segments being about equal in length.

Hab. St. Vincent.

A common species variable in colour and size; described from many specimens.

Pteromalus, *Swed.*

Pteromalus rugosopunctatus, sp. n.

♂ ♀. Length 1·5 to 2·5 millim. Black or blue-black, the disk of mesonotum sometimes with an æneous tinge, and sometimes sparsely pubescent; head and thorax somewhat coarsely confluently punctate; face with striæ towards the mouth; scape and sometimes the pedicel and legs, except coxæ, pale yellowish; sometimes all the femora, except tips, black, more rarely with only a brownish blotch; flagellum brown, the first joint the longest, or twice as long as thick, the following to club subequal, not quite twice as long as thick. Thorax as in *Catolaccus pallipes*, except the mesonotum has the quadrilateral areas, the neck large and strongly punctate, the scutellum with a cross-furrow before the tip. Wings hyaline, the tegulæ and venation pale, the marginal vein two and a half times as long as the stigmal. Abdomen conic-ovate, much longer than the head and thorax united, metallic or bluish, the segments as in *C. vulgaris*.

The male has the same coarse punctuation and agrees in colorational detail with the female, but with the following structural differences:—The first and second funicle-joints are equal, a little shorter than the others; the abdomen is ovate, shorter than the thorax, briefly petiolated, with the dorsum at base usually cupreous, while the legs, as in the female, are variable.

Hab. St. Vincent.

Described from many specimens of both sexes.

Subfamily Eulophinæ.

Hoplocrepis, *Ashm.*

Hoplocrepis albiclavus, *Ashm. Proc. Ent. Soc. Wash.* vol. i. p. 235.

Hab. Florida and St. Vincent.

Of this curious genus, described by the writer from a single female specimen collected in Florida, are two female and five male specimens that cannot be separated specifically from the Floridian specimen. The male, which was unknown to me when I erected the genus, differs from the female in having the funicle-joints of antennæ round, strongly pedicellated, and with whorls of very long hairs, while the front wings lack the conical tufts of bristles at the origin of the marginal vein. The antennæ in the male recall those in the Entedonid genus *Lophocomus*, Haliday.

Paraolinx, gen. nov.

Allied to *Olinx*, Förster, but differs as follows:—The antennæ are flattened in both sexes, the funicle being 4-jointed; in the male the joints are strongly excised and pedicellate, in the female transverse. Pronotum short, transverse; mesonotum a little wider than long, with distinct parapsidal furrows; metanotum short. Tibial spurs 1, 1, 2, the middle spurs long, the hind spurs short, weak. Abdomen ovate, with a short petiole. Venation similar to *Sympiesis*, Förster, the marginal vein long, about as long as the submarginal, or only three times as long as the stigmal.

The flattened antennæ and the strongly excised pedicellate funicle-joints of the male separate the genus at once from all other described genera in the tetramerous Chalcididæ.

Paraolinx lineatifrons, sp. n.

♂ ♀. Length 1 to 1·3 millim. Brown-black, confluently punctate; frons and face in the female and the whole head in the male, except the occiput, a transverse band on collar, and a line on the middle lobe of mesonotum parallel with the furrows yellow; frons and face impressed with transverse black lines; scape and legs pallid or whitish. Wings hyaline, with the apical margins ciliate. Abdomen æneous or submetallic, the male with a large white blotch at base.

Hab. St. Vincent.

Described from two male and four female specimens, only a single specimen of each sex being perfect, the others having lost their antennæ, or are otherwise imperfect.

Eulophus, *Geoffroy*.

Eulophus auripunctatus, sp. n.

♀. Length 2 millim. Pale honey-yellow; mesonotum, except laterally and its margin before the scutellum, golden green and strongly punctate; basal segment of abdomen cupreous, the following segments yellowish, with a black band at apex; flagellum black, pubescent, the last three funicle-joints fully twice as long as thick, the first much shorter.

Hab. St. Vincent.

Described from a single specimen.

DIGLYPHUS, *Thomson.*

DIGLYPHUS? ALBIPES, sp. n.

♀. Length 3·1 millim. Black, with an æneous tinge; the collar, postscutellum, and abdomen, except tip, ferruginous; antennæ, except toward tips, and legs white; mesonotum and metanotum rugose; rest of the surface smooth. The antennæ extend to the metathorax, and are similar to those in *Sympiesis*; the funicle 4-jointed, the first joint long, about two thirds the length of the scape, following joints about equal or two thirds the length of the first. Thorax with several long black bristles, the collar triangular, the mesonotum with distinct but delicate parapsidal furrows, scutellum with two furrows. Wings hyaline, the marginal vein very long, longer than the submarginal, or about five times as long as the stigmal. Abdomen conic-ovate, a little longer than the head and thorax united, subpetiolated, with the first segment the longest.

♂. Length 2·2 millim. Agrees well with the female, except that the head, thorax, and basal abdominal segment are metallic green or cupreous; axillæ and scutellum smooth, the latter sometimes with a longitudinal furrow as in *Holcopelte*; while the first funicle-joint is only a little longer than the second.

Hab. St. Vincent.

Described from one female and two male specimens.

DIGLYPHUS? MACULIPENNIS, sp. n.

♂ ♀. Length 1·5 to 2·3 millim. Æneous or bronzed, shagreened; scape, pedicel, and legs honey-yellow or white; flagellum brown-black; scutellum smooth, with a grooved line at the sides and another at the middle; flagellum filiform, the funicle 4-jointed, the joints elongate, subequal in length; abdomen sessile, conic-ovate, about as long as the head and thorax united, the basal segment the longest, occupying a little less than half the length of the abdomen, and foveated at the base by the produced neck of the metathorax. Wings hyaline, pilose, with a large fuscous discoidal blotch, the marginal vein fully as long as the submarginal; the stigmal vein long, subclavate, and very oblique, about two thirds the length of the post-marginal.

The male differs in having all the coxæ metallic and the abdomen short ovate, only about half the length of the thorax.

Hab. St. Vincent.

Both the above species are doubtfully referred to Thomson's

genus *Diglyphus*, in which they differ in having a 4-jointed funicle and distinct parapsidal furrows. The posterior tibiæ in both species are two-spurred.

Subfamily ENTEDONINÆ.

OMPHALE, *Haliday*.

OMPHALE VARICOLOR, sp. n.

♂ ♀. Length 1·4 to 2·8 millim. Variable in colour from a dark blue to metallic green, or bronzed, and rather coarsely scaly-punctate. The female is most frequently metallic green, with the coxæ and femora metallic, the rest of the legs and the scape yellowish; flagellum dark brown, pubescent, sometimes wholly steel-blue or dark blue, with the upper surface of thorax bronzed or metallic green, the coxæ and femora blue, and more rarely with the tibiæ brown or blue. The blue specimens usually have only the tarsi white. Antennæ 9-jointed, the club 3-jointed, the funicle 4-jointed; the pedicel is smooth, obconic; the first funicle-joint is the longest, nearly three times as long as thick, the following joints subequal, the fourth being only a little longer than thick. Wings hyaline, very finely pubescent, the pubescence arranged in faint lines; the venation yellowish, the submarginal vein about two thirds the length of the marginal, the stigmal very minute, ending in a small round stigma, the postmarginal vein short, but still longer than the stigmal. Metathorax very short, nearly in a vertical line with the tip of the scutellum; the spiracles large, oval; the metapleura divided by a grooved line that extends to the base of the hind coxæ. Abdomen sessile, acutely produced at tip, and longer than the head and thorax united; the sheaths of ovipositor prominent.

The male is smaller and very variable in size and colour, although most frequently blue or bluish green with white tarsi, more rarely metallic green. The antennæ are 9-jointed, the club 2-jointed, the funicle 5-jointed, the joints of the latter being pedicellated and furnished with whorls of long white hairs; the marginal vein is not longer than the submarginal, and the postmarginal is sometimes wanting; while the abdomen is ovate, shorter than the thorax.

Hab. St. Vincent.

Described from 8 male and 27 female specimens.

HOLCOPELTE, *Förster*.

This genus is well represented in St. Vincent, and the several species recognized may be separated by the aid of the following table.

Table of Species.

Neck of metathorax not especially produced; petiole not especially long, usually short....	2.
Neck of metathorax strongly produced; the petiole very long.	
Colour variable, from cupreous to blue; scape and legs, including coxæ, white; funicle in both sexes 4-jointed, the joints in the male pedicellate, with long hairs	*H. petiolatus*, sp. n.
2. Coxæ white	4.
Coxæ metallic or blue; funicle in female 3-jointed, in male 4-jointed.	
Scape white............................	3.
Scape metallic or dark.	
Trochanters, except sometimes the anterior pair, tips of femora, and the tibiæ and tarsi yellowish or white.	
Cupreous or metallic; face and frons coarsely punctate; second abdominal segment not longer than the following segments united, the petiole a little longer than wide, punctate.	
Female with the funicle-joints oblong; male with the joints oblong-moniliform, pubescent	*H. metallicus*, sp. n.
Blue-black; face and frons faintly scaly; second abdominal segment longer than the following segments united, the petiole not longer than wide.	
Female with the funicle-joints 2 and 3 transverse-moniliform; male with the flagellum filiform-moniliform ..	*H. nigrocyaneus*, sp. n.
3. Legs, except coxæ, white.	
Cupreous; second abdominal segment shorter than the following segments united.	
Female with funicle-joints longer than wide; male with the funicle-joints longer than wide, subpedunculated, and furnished with long white hairs	*H. cupreus*, sp. n.

Æneous black; second abdominal segment much longer than the following segments united.
Female with the funicle-joints 2 and 3 moniliform .... *H. nigroæneus*, sp. n.

4. Metallic, bronze or subcupreous.
Legs and scape white; flagellum in female pale brown or yellowish, in male brown-black.
Abdomen conically produced, longer than the head and thorax united, the second segment the longest, but its length only about one third as long as the following segments united.
Female with the funicle-joints long; male with the funicle-joints longer than wide, hairy .... *H. productus*, sp. n.

HOLCOPELTE PETIOLATUS, sp. n.

♂ ♀. Length 1·5 to 2 millim. Blue-black to cupreous, rarely without a metallic tinge on head and thorax above, the thorax scaly-punctate; in female the scape and legs, including coxæ, white; in male the coxæ usually black: flagellum black. Head wider than the thorax; eyes large, hairy; funicle 4-jointed in both sexes, in the female the joints are long, subpedunculate, hairy, in male distinctly pedunculate, with longer hairs. Pronotum conical, much narrower than the mesonotum; scutellum with a median groove; metathorax produced into a neck at apex. Wings hyaline, fringed, the marginal vein very long, more than twice the length of the submarginal, postmarginal scarcely developed, stigmal very short. Abdomen with a long petiole; in the female with the body produced at tip as in the Pteromalid genus *Isocratus*, in male truncate at apex. In both sexes the first body-segment is very long and foveated at base above for the reception of the long petiole.

Hab. St. Vincent.

Described from seven male and four female specimens.

In the shape of the abdomen with its long petiole, the strongly produced neck of the metathorax, and in both sexes having four joints to the funicle, this species is quite distinct from those that follow. In fact, I think these characters entitle it to subgeneric rank.

HOLCOPELTE METALLICUS, sp. n.

♂ ♀. Length 1·5 to 2 millim. Metallic greenish; antennæ,

coxæ, and femora, except tips, metallic, the rest of the legs honey-yellow or whitish; anterior legs in male usually wholly honey-yellow. Frons and face strongly punctate; thorax scaly.

In the female the flagellum is subclavate, with a 3-jointed funicle, the first joint the longest, the following subequal, all oblong; abdomen pointed ovate, as long as, or a little longer than, the thorax, the second segment the longest, about as long as the following segments united; segments 7 and 8 are a little longer than any of the others except the second; the petiole is only a little longer than wide.

In the male the flagellum is filiform-moniliform, the joints subpedicellate, very little longer than thick; abdomen oval, scarcely half the length of the thorax, the apex usually truncate, from the apical segments being retracted within the large second segment; the petiole is longer than in the female.

Hab. St. Vincent.

Described from 6 male and 14 female specimens.

Holcopelte nigrocyaneus, sp. n.

♂ ♀. Length 1 to 2 millim. Blue-black, rarely with a slight æneous tinge, scaly-punctate; trochanters, tips of femora or knees, and the tibiæ and tarsi pale yellowish or white; sometimes in the female the anterior legs, except coxæ, are white, while in the male all the legs, except the coxæ and the posterior femora, are white, although sometimes in this sex the tibiæ are dusky.

In the female the flagellum is clavate or subclavate, with the 2nd and 3rd funicle-joints transverse-moniliform; abdomen ovate, not quite as long as the thorax, the petiole not or scarcely longer than wide, the second segment usually as long as, or a little longer than, the following segments united.

In the male the flagellum is filiform, hairy, the funicle-joints oblong-moniliform, subpedicellate.

Hab. St. Vincent.

Described from many specimens.

Holcopelte cupreus, sp. n.

♂ ♀. Length 1·5 to 2 millim. Cupreous; scape and legs, except coxæ, white; flagellum black; punctation scaly.

In the female the flagellum is filiform, pilose, the funicle-joints long, subpedicellate; abdomen ovate, pointed at apex, the petiole short, the second segment the longest but shorter than the following segments united.

In the male the flagellum is metallic, covered with long fine hairs, the funicle 4-jointed, the joints pedicellate; abdomen rounded, briefly petiolated, the petiole being punctate.

Hab. St. Vincent.

Described from two male and nine female specimens.

Comes nearest to *H. metallicus*, but readily distinguished by the colour of the antennæ and legs and the shape of the funicle-joints.

HOLCOPELTE NIGROÆNEUS, sp. n.

♂ ♀. Length 1 to 2 millim. Æneous black, scaly-punctate; scape and legs, except coxæ, white; flagellum dark brown.

In the female the flagellum is filiform, the funicle 3-jointed, the joints subpedicellàte, the 2nd and 3rd round-moniliform; abdomen ovate, the petiole a little longer than thick, shagreened, the second segment much longer than all the following segments united.

The male is blue-black, with a cupreous tinge above; the flagellum pilose, the joints oblong-moniliform, subpedicellate; abdomen small, truncate at apex, with a rather long petiole.

Hab. St. Vincent.

Described from one male and nine female specimens.

HOLCOPELTE PRODUCTUS, sp. n.

♂ ♀. Length 1 to 1·5 millim. Metallic, bronze or subcupreous, faintly and feebly shagreened; the scape and legs, including the coxæ, white; flagellum yellowish. Abdomen conically produced, longer than the head and thorax united, the petiole wider than long, the second segment the longest but only about one third as long as the following segments united; flagellum filiform, the joints long. Wings hyaline, the marginal vein very long, three times as long as the submarginal; stigmal vein clavate, the postmarginal a little longer than the stigmal.

In the male the abdomen is oval, subsessile, pointed at apex; flagellum black-pilose; while in this sex the anterior coxæ are dark.

Hab. St. Vincent.

Described from one male and three female specimens.

The conically produced abdomen of the female and the venation readily separate this species from those previously described.

DEROSTENUS, *Westwood*.

Table of Species.

Females.

Abdomen almost round..................	2.
Abdomen conically produced or conic-ovate.	
Bronze-green; legs pale yellowish.	
Front wings with 4 brown spots	*D. quadrimaculatus*, sp. n.
Thorax gold-green, scaly-punctate, rarely bronzed; head, thorax, and abdomen beneath blue-black, the abdomen above more or less metallic; legs, except anterior coxæ, and scape white.	
Front wings hyaline	*D. acutus*, sp. n.
2. Æneous; scape and legs white	*D. rotundus*, sp. n.

Males.

Abdomen ovate; head and abdomen purplish, the thorax greenish æneous; scape and legs, except anterior coxæ, white......	*D. acutus*, sp. n.
Abdomen round; bluish or purplish, the thorax with an æneous tinge above; abdomen with a transverse white spot at base; scape and legs, except coxæ and a dusky streak on femora, white	*D. rotundus*, sp. n.

DEROSTENUS QUADRIMACULATUS, sp. n.

♀. Length 1·1 millim. Bronze-green, the thorax feebly shagreened; antennæ except club, and legs except coxæ pale brownish yellow; club brown-black; hind coxæ blue. The antennæ are 9-jointed; the first funicle-joint is smaller than the 2nd and 3rd, which are about equal; the 4th is quadrate, larger and thicker than the preceding and distinctly separated from the club and the 3rd funicle-joint; the club is 3-jointed, conic-ovate, and nearly three times as long as the last funicle-joint. Wings hyaline, with four brown maculæ: one at the middle of the marginal vein, another enclosing the stigmal vein; while the other two are on the hind margin, each being directly opposite those first mentioned. Abdomen conic-ovate, longer than the head and thorax united, and produced into a prominent though short oviduct at the tip.

Hab. St. Vincent.

Described from a single specimen.

The spotted anterior wings and the shape of the abdomen readily distinguish the species.

DEROSTENUS ACUTUS, sp. n.

♂ ♀. Length 1 millim. Thorax gold-green, scaly-punctate; head wider than thorax, smooth, blue-black or purplish with an æneous tinge; flagellum dark brown, covered with a whitish pubescence; scape and legs white; thorax and abdomen beneath purplish or bluish, the latter above with an æneous tinge. Wings hyaline. The abdomen is acutely produced, briefly petiolated, and as long as the head and thorax united.

The male agrees well with the typical female except in the antennæ, shape of abdomen, and the colour of the anterior coxæ; the flagellar joints are slightly longer, with long hairs, the anterior coxæ bluish or metallic, the middle and posterior coxæ usually dusky at base, while the abdomen is subovate or spatulate.

Hab. St. Vincent.

Described from two male and twelve female specimens.

DEROSTENUS ROTUNDUS, sp. n.

♂ ♀. Length 0·65 to 0·8 millim. Blue-black or purplish, impunctate, the upper part of thorax and abdomen æneous; flagellum brown-black; scape and legs white; wings hyaline; abdomen rounded, briefly petiolated, not longer than the thorax, usually shorter: flagellar joints in female about twice as long as thick, pubescent; in male shorter, with longer hairs.

Hab. St. Vincent.

Described from six male and four female specimens.

The rounded abdomen distinguishes this species from all others in the genus.

CHRYSOCHARIS, *Förster*.

Table of Species.

Females.

Thorax brownish yellow, with a violaceous tinge
  anteriorly .... 2.
Thorax always metallic or blue-black.
  Abdomen conic-ovate.
    Blue-black.
      Thorax and abdomen metallic green, the former
        scaly-punctate; legs entirely white.
      Anterior wings with a substigmal blotch .. *C. stigmatus*, sp. n.

Thorax above sometimes metallic, smooth; legs bluish, tarsi alone white.
Anterior wings hyaline .... *C. lividus*, sp. n.
Abdomen rounded.
Thorax and abdomen metallic green, the former scaly-punctate; scape and legs white ..... *C. lividiceps*, sp. n.
2. Abdomen conic-ovate; head black, abdomen brownish black.
Legs honey-yellow .... *C. thoracicus*, sp. n.

Males.

Blue-black.
Head posteriorly metallic; legs blue, with the tarsi alone white; wings hyaline .... *C. lividus*.
Occiput and thorax above metallic or bronze-green; legs white; wings with a substigmal blotch .... *C. stigmatus*.
Head much wider than thorax, blue; thorax above golden green, scaly-punctate; legs, except coxæ and scape, white .... *C. lividiceps*.

CHRYSOCHARIS STIGMATUS, sp. n.

♂ ♀. Length 1·1 to 1·2 millim. Blue-black; in female with the upper part of thorax metallic green; in male with only the scutellum and metathorax tinged with æneous, smooth. Scape and legs, except coxæ in the male, whitish or honey-yellow. Head rather large, the frons impressed, the vertex acute. Prothorax distinct, narrowed anteriorly. Wings hyaline, ciliated, with a brownish blotch beneath the stigmal vein. Abdomen in female ovate, in male oblong, the short petiole in the latter brown.

Hab. St. Vincent.

Described from one male and one female specimen.

The shape of the head and the collar strikingly resemble those in the genus *Derostenus*; but the number of joints in the antennæ being one less, cause me to place this species in *Chrysocharis*. It is readily distinguished by the substigmal blotch in the anterior wing.

CHRYSOCHARIS LIVIDUS, sp. n.

♂ ♀. Length 0·85 to 1 millim. Blue-black, impunctured, the tarsi and tibial spurs alone white. Wings hyaline. Abdomen in female subsessile, ovate, about as long as the thorax; in

male oblong, with a whitish spot at base; the antennæ with whitish hairs, the first funicle-joint the longest.

Hab. St. Vincent.

Described from one male and one female specimen.

Chrysocharis lividiceps, sp. n.

♂ ♀. Length 1·2 millim. Thorax and abdomen metallic or gold-green, the former scaly-punctate; head and thorax, at sides and beneath, blue-black; the small side-piece at base of hind wings violaceous; scape and legs white; flagellum brown, pubescent. Wings hyaline, pubescent. Abdomen rounded, only two thirds the length of the thorax.

The male is slightly smaller, measuring but 1 millim in length, and with the head larger, the flagellum longer, with longer black hairs, the flagellar joints somewhat contracted at tips, while the coxæ are æneous; otherwise it resembles the female.

Hab. St. Vincent.

Described from three males and one female.

Chrysocharis thoracicus, sp. n.

♀. Length 1·5 millim. Head black; thorax and legs pale brownish yellow, the former with a distinct violaceous tinge anteriorly; antennæ pale brown, hairy, the funicle-joints elongate. Wings large, hyaline and ciliate. Abdomen conic-ovate, as long as the head and thorax together, brown-black, the very short petiole yellow.

Hab. St. Vincent.

Described from a single female.

Closterocerus, *Westwood.*

Table of Species.

Females.

Blue-black; tarsi white.... .... *C. leucopus*, sp. n.

Males.

Blue-black; tarsi white......... .... *C. leucopus.*

Blue-black; head above metallic green; legs white, the femora and tibiæ dusky at the middle.

Abdomen without a pale spot at base .... *C. auriceps*, sp. n.

Æneous black, metathorax and abdomen bluish, the latter with a white spot at base; legs white...... *C. albipes*, sp. n.

CLOSTEROCERUS LEUCOPUS, sp. n.

♂ ♀. Length 0·8 to 0·9 millim. Blue-black, impunctured, the scutellum and base of abdomen more distinctly blue; sometimes with an æneous tinge; tarsi white. Wings hyaline, ciliated. Abdomen in female pointed ovate, as long as the head and thorax united; in male oblong, narrowed towards base, and not longer than the thorax. Antennæ short, fusiform, pilose.

Hab. St. Vincent.

Described from one female and four male specimens.

CLOSTEROCERUS AURICEPS, sp. n.

♂. Length 0·8 millim. Blue-black, the scutellum æneous, the head above metallic green or gold-green; legs pale or white, the coxæ æneous, the femora and tibiæ dusky at the middle. Wings clear hyaline, fringed. Abdomen oval, shorter than the thorax, with no pale spot at base.

Described from a single male specimen.

CLOSTEROCERUS ALBIPES, sp. n.

♂. Length 0·8 millim. Æneous black, the metathorax and abdomen bluish, the latter with a large white spot at base; collar anteriorly with a violet tinge; legs white, with only the coxæ dusky basally. Wings hyaline, pubescent. Antennæ 8-jointed, flattened, brown, pubescent, the third funicle-joint the longest.

Hab. St. Vincent.

Described from two male specimens.

CHRYSOCHARODES, gen. nov.

Allied to *Chrysocharis*, Förster, and *Derostenus*, Westwood, but separate at once from both by its antennal characters. In both sexes the antennæ are 7-jointed, not 8- or 9-jointed; in the female they are subclavate, pubescent, with a 2-jointed funicle and a 3-jointed club; in the male the funicle is 3-jointed, each joint contracted at apex into a pedicel, while the base or thickened part is furnished with a whorl of long hairs; club only 2-jointed. The head is rather large, transverse, with a frontal impression pronotum conical; metathorax somewhat lengthened; the abdomen is oval, much shorter than the thorax, distinctly petiolated, and with the second segment the longest, twice as long as the third.

CHRYSOCHARODES PETIOLATA, sp. n.

♂ ♀. Length 1·1 millim. Blue-black, upper part of thorax and base of abdomen with a metallic tinge; disk of thorax scaly-punctate; metapleura and coxæ bluish; legs brownish yellow; antennæ, including scape, black or dark brown; flagellum once and a half as long as the scape, pubescent, the second funicle-joint a little longer than the first; club 3-jointed, fusiform, distinctly separated from the funicle. Wings hyaline, ciliated, the short stigmal vein ending in a small round stigma with an uncus. Abdomen oval, two thirds the length of the thorax, the petiole once and a half as long as wide, shagreened.

The male is at once distinguished from the female by the antennæ, the funicle being 3-jointed, the joints pedicellate at tips and with whorled hairs; club 2-jointed; thorax above golden green, scaly; while the abdomen is oblong, with the petiole fully twice as long as wide.

Hab. St. Vincent.

Described from one male and one female specimen.

Subfamily TETRASTICHINÆ.

CERATONEURA, gen. nov.

Antennæ 10-jointed; in female subclavate, with two ring-joints and a 3-jointed club, covered with a fine pubescence: in male filiform, with one ring-joint and a 4-jointed funicle, the funicle-joints contracted toward apex and with long hairs. Head transverse; the ocelli subtriangularly arranged, the laterals being much closer to the front ocellus than to the margin of the eye: eyes broadly oval; frons with two grooves for the scapes of the antennæ. Thorax subovoid, the pronotum short, the mesonotum without a median furrow; the scutellum convex, without the grooved lines on disk; the metathorax very short, smooth, rounded behind, with a delicate median carina. Wings, except the posterior pair, as in *Tetrastichus*; hind wings with a long clavate marginal vein. Abdomen briefly but distinctly petiolated, in female ovate, pointed at tip, in male oval.

In the distinct petiole, and in other characters pointed out, this genus is quite distinct from all others placed in this group. The female antennæ agree with *Tetrastichus*, Hal.; but the male antennæ are different, and the wholly different mesonotum and scutellum readily separate it. The other genera having no

furrows on mesonotum and scutellum are *Anozus*, Förster, *Gyrolasia*, Förster, and *Syntomosphyrum*, Förster; but the absence of a stigmal vein and difference in antennæ distinguish *Anozus*, the sessile abdomen, strongly fringed wings, and 8-jointed antennæ distinguish *Gyrolasia*, while *Syntomosphyrum* is separated by the sessile abdomen, 8-jointed antennæ with no ring-joints, and the venation of hind wings.

CERATONEURA PETIOLATA, sp. n.

♂ ♀. Length 1·5 to 1·9 millim. Black, smooth, impunctured; face with striæ converging towards mouth; petiole of abdomen yellow; scape, trochanters, tips of femora, tibiæ, and tarsi honey-yellow; rest of legs black; flagellum brown.

In the female the flagellum is subclavate, the funicle-joints about twice as long as wide, the club thicker, fusiform; in male filiform, much longer, pilose, the funicle-joints three or more times longer than wide. Wings hyaline, with a short fringe at the margins. Abdomen in female ovate, about as long as the thorax.

Hab. St. Vincent.

Described from twelve female specimens.

CERATONEURA PALLIDA, sp. n.

♂. Length 2 millim. Pale brownish yellow, smooth; face with striæ converging toward mouth; eyes and abdomen laterally and at apex brown; scape, pedicel, and legs whitish. Wings hyaline. Abdomen oval, a little shorter than the thorax, the segments very nearly equal in length. The scape beneath towards apex is slightly dilated, while the funicle-joints are more than three times as long as wide.

Hab. St. Vincent.

Described from a single male specimen.

GYROLASIA, *Förster*.

Table of Species.

Females.

Body entirely black or metallic .... 2.

Head and thorax black, smooth, shining; abdomen conic, brown.

Legs honey-yellow, the coxæ and femora black or brown.......................... *G. bicolor*, sp. n.

2. Black, the thorax above æneous or black.
   Abdomen conic-ovate; legs pale or yellowish, the hind coxæ and femora alone dusky .... *G. ciliata*, sp. n.
   Abdomen conically produced, longer than the head and thorax united; all coxæ dusky or black; anterior and middle femora dusky at middle; hind femora slightly swollen, dark brown or black .... *G. femorata*, sp. n.
  Metallic or bronze-green.
   Abdomen oval, a little longer than the thorax; legs pale or honey-yellow................ *G. metallica*, sp. n.

GYROLASIA BICOLOR, sp. n.

♀. Length 0·85 millim. Head and thorax black, shining, impunctured; abdomen conic-ovate, a little longer than the head and thorax together, brown; flagellum and legs (except trochanters, tibiæ, and tarsi, which are honey-yellow) brown-black. Wings hyaline, strongly fringed.

Hab. St. Vincent.

Described from one female specimen.

GYROLASIA CILIATA, sp. n.

♀. Length 0·8 millim. Head and thorax, except above, and the abdomen black; thorax above æneous black; antennæ brown; the flagellum rather long, filiform, with long hairs; legs, except a dusky shade at base of hind coxæ and their femora, pale or yellowish white. The whole surface is smooth, shining; the wings hyaline, with a very long fringe; while the abdomen is conic-ovate, very little longer than the head and thorax united.

Hab. St. Vincent.

Described from two female specimens.

GYROLASIA FEMORATA, sp. n.

♀. Length 0·8 to 1 millim. Black, smooth, impunctured; flagellum subclavate, brown, pubescent; legs, except coxæ and femora, whitish or pale honey-yellow, the coxæ brown or black, the anterior and middle femora usually dusky or brown-black. Wings hyaline, strongly fringed. Abdomen conically produced, about one third longer than the head and thorax united.

Hab. St. Vincent.

Described from eight female specimens.

GYROLASIA METALLICA, sp. n.

♀. Length 0·85 millim. Metallic or bronze-green, impunctate, the under surface of thorax and abdomen blue-black; flagellum brown, pubescent; legs pale or honey-yellow, the coxæ alone showing a dusky spot at base. Wings hyaline, strongly fringed. Abdomen oval, a little longer than the thorax.

Hab. St Vincent.

Described from one female specimen.

In the metallic colour, more compact form, the collar not being narrowed before, and in the shape of the abdomen this species is widely separated from all the others.

SYNTOMOSPHYRUM, *Förster*.

SYNTOMOSPHYRUM INSULARIS, sp. n.

♀. Length 0·9 millim. Black, smooth, shining; the trochanters, knees, tips of tibiæ, and tarsi honey-yellow; scape pale brown; flagellum brown-black, pubescent, scarcely as long as the head, the joints short, submoniliform. The head is transverse, excavated, or concave behind, the occipital margin being sharp; frons deeply impressed, the anterior ocellus being in the furrow, while the lateral ocelli are nearer to the front ocellus than to the margin of the eye. Thorax short, ovoid, the collar transverse, visible from above as a curved line; mesonotum a little wider than long, with deeply defined parapsides, the middle lobe being scarcely longer along the sides than the width anteriorly; scutellum smooth, without distinct grooved lines, rarely slightly indicated at extreme base. Wings hyaline, pubescent, the nervures pale brownish, margins fringed with short cilia. Abdomen oval, not quite as long as the thorax.

♂. Length 1 millim. Differs from the female in having much longer filiform antennæ, the joints of the flagellum much longer than thick, pubescent, the anterior and middle legs brownish yellow, while the abdomen is oblong, much narrower than the thorax, and as long as the head and thorax united.

Hab. St. Vincent.

Described from one male and one female specimen.

TETRASTICHODES, *Ashmead*.

This name was proposed, some years ago, for a Tetrastichid found in Florida. It differs from *Tetrastichus*, Haliday, in

having no median furrow on the mesoscutum, a character peculiar to the genera *Ceranisus*, Walk., *Baryscapus*, Först., *Melittobia*, Westw., and *Cirrospilus*, Westw.; but *Ceranisus* and *Baryscapus* have the scape greatly thickened or dilated, in *Melittobia* the female has a conically produced collar and eight-jointed antennæ, the male being subapterous with dilated and twisted antennæ and subobsolete eyes, while *Cirrospilus* has but seven-jointed antennæ.

The two species placed here, from St. Vincent, may be thus distinguished:—

Smooth, impunctate, metallic green or cupreous; abdomen conically produced.
Legs, except hind coxæ, white .... *T. cupreus*, sp. n.
Scaly-punctate, dull bronzy-brown or bronze-green; abdomen cylindrical, conically pointed.
Coxæ and hind femora black, the anterior and middle femora, except tips, dark brown, rest of legs yellow .... *T. femoratus*, sp. n.

TETRASTICHODES CUPREUS, sp. n.

♂ ♀. Length variable, from 0·9 to 2 millim. Metallic green or cupreous, smooth, impunctate; scape and legs yellowish or pale brownish-yellow; hind coxæ metallic green; flagellum brown. Abdomen in male ovate or conic-ovate, not or very slightly longer than the thorax, with a yellow blotch at base; in female conically produced, a little longer than the head and thorax united, and without the yellow blotch at base.

Head transverse, with a deep frontal impression; mandibles piceous or ferruginous; the anterior ocellus is situated in the frontal impression, the lateral ocelli being as near to the margin of the eye as to the frontal ocellus. Thorax ovate, the collar rounded anteriorly, the mesonotum slightly longer than wide, the middle lobe being longer than wide along the anterior margin; scutellum convex, with two furrows; metathorax smooth. Wings hyaline, pubescent, the cilia short, the venation pallid. Antennæ in female subclavate, pubescent, the funicle-joints being not more than twice as long as wide; club a little stouter, 3-jointed: in male filiform, pilose, the funicle-joints at least three times (or slightly more) as long as wide.

Hab. St. Vincent.

Described from 10 male and 24 female specimens.

TETRASTICHODES FEMORATUS, sp. n.

♂ ♀. Length 1·5 to 2 millim. Scaly-punctate, bronzy-brown or metallic green, the head somewhat purplish ; scape, pedicel, and legs honey-yellow ; middle and anterior femora towards base and the terminal tarsal joint brownish ; all coxæ and hind femora, except tips, black ; flagellum brown. The flagellum in female clavate, the first funicle-joint longer than wide, the second and third quadrate ; club fusiform, 3-jointed. Abdomen in female conic-ovate, cylindric, very slightly longer than the head and thorax united, scaly-punctate, the segments 1, 2, and 3 long, about equal, occupying most of the surface : in male oblong-oval, not longer than the thorax.

Hab. St. Vincent.

Described from one male and one female specimen.

TETRASTICHUS, *Haliday*.

This genus is numerously represented in all parts of the world and the species are exceedingly difficult to separate. Mr. F. Walker, in his 'Monographia Chalcididum,' under the genus *Cirrospilus* has described numerous species from England and elsewhere ; but as he gave no tables of his species, and, moreover, seems to have confused several genera under this genus, I have been unable to follow him, and the species described by me may or may not be identical with some of his species.

The six species in the St. Vincent collection may be distinguished by the following table :—

Species pale .... 3.
Species black or blue-black, smooth or but feebly sculptured .... 2.
Bright metallic green to blue-green, rather strongly punctate.
Legs, except coxæ, brownish yellow or reddish yellow .... *T. cupreus*, sp. n.

2. Blue-black, subopaque, or black, shining.
No pale spot at base of abdomen.
Abdomen in female conic-ovate.
a. Subopaque.
Scape and legs, except coxæ and femora, brownish yellow ; antennæ not especially long ; mesoscutum with a row of punctures at the lateral margins .... *T. vulgaris*, sp. n.

b. Shining, black.

Scape, pedicel, and legs honey-yellow or pale brownish yellow; hind femora sometimes more or less dusky; antennæ long; mesoscutum without a row of punctures at the lateral margins ...... *T. longicornis*, sp. n.

Antennæ short; legs, except coxæ and femora, pale brownish or honey-yellow; hind wings acute at tips .... *T. acutipennis*, sp. n.

A pale spot at base of abdomen.

Black with a faint æneous tinge.

Scape, legs, and basal abdominal segment honey-yellow, the femora dusky towards base............................ *T. basilaris*, sp. n.

3. Brown or brownish yellow.

Frons not closely punctured with thimble-like punctures, at the most with only a row of punctures.

Apex of antennæ, head and thorax above, and the apex of the abdominal segments dusky or brown.................... *T. fasciatus*, sp. n.

Frons closely punctured with thimble-like punctures .... *T. punctifrons*, sp. n.

TETRASTICHUS CUPREUS, sp. n.

♂ ♀. Length 1·5 to 2 millim. Bright metallic green or cupreous, more rarely bluish green, punctate; scape, pedicel, and legs, except coxæ, yellow; coxæ metallic; flagellum brown, pubescent. Head transverse, a little wider than the thorax, punctate, the vertex rounded; ocelli red, connected by grooved lines; frons with a V-shaped antennal impression. Flagellum in female brown, pubescent, with two ring-joints, the funicle-joints oblong; club stout, fusiform, 3-jointed: in male filiform, pilose, the first funicle-joint scarcely longer than thick, the following joints almost equal, oblong, from 1½ to 2 times as long as thick. Thorax subovoid, with the collar distinct, transverse, rounded anteriorly; mesonotum not quite as long as wide, with distinct parapsidal furrows, the middle lobe with a median grooved line, usually subobsolete anteriorly, and with two punctate lines along the lateral margins; scutellum convex, with two lines on disk and a short median line at base; metathorax short, areolated; pleura and coxæ strongly punctate. Wings hyaline, pubescent, the venation yellowish. Abdomen sessile, ovate, cylindric,

punctate; in female rarely longer than the thorax, in male shorter, the first segment the longest, the following segments short, nearly equal.

Hab. St. Vincent.

Described from 145 specimens.

TETRASTICHUS VULGARIS, sp. n.

♀. Length 1·5 to 2 millim. Blue-black at sides and beneath; the dorsum black, subopaque, feebly shagreened; abdomen conic-ovate, æneous black; scape, pedicel, trochanters, knees, tibiæ, and tarsi honey-yellow; flagellum brown. Head transverse, antero-posteriorly very thin, the vertex therefore very sharp; frons deeply impressed, punctate; trophi ferruginous. Antennæ shorter than the thorax, the pedicel $\frac{1}{3}$ the length of the scape; the flagellum subclavate, very slightly more than twice the length of the scape, brown, pubescent, the three funicle-joints a little longer than thick, the third the widest; club stouter, 3-jointed. Thorax short, ovoid, feebly shagreened, subopaque; pronotum short, visible from above as an arcuate ridge; mesonotum wider than long, the middle lobe with a median grooved line and a row of punctures along the parapsidal furrows; parapsides with an oblique line just above the tegulæ; scutellum convex, with two median grooved lines; metathorax very short, abrupt. Wings hyaline, pubescent, the venation pale yellowish. Abdomen conic-ovate, a little longer than the head and thorax united, depressed or flat above, boat-shaped beneath.

Hab. St. Vincent.

Described from 58 female specimens.

TETRASTICHUS LONGICORNIS, sp. n.

♀. Length 1·5 to 1·8 millim. Black, shining, much slenderer than *T. vulgaris*; the antennæ very long, extending to base of abdomen or beyond, the flagellum being filiform and nearly five times as long as the scape, the joints elongate, about three and a half times as long as thick. Thorax smooth, the collar conical, the mesoscutum without a row of punctures along the parapsidal furrows. Wings hyaline, pubescent, the venation pale brownish yellow. Legs pale yellowish, the femora more or less dusky medially, the anterior pair sometimes entirely pale. Abdomen as in *T. vulgaris*, but piceous along the venter.

Hab. St. Vincent.

Described from nine female specimens.

The long antennæ, closely resembling those of a male, the conical pronotum and its smooth surface, readily distinguish the species.

TETRASTICHUS ACUTIPENNIS, sp. n.

♀. Length 0·9 millim. Black, shining, impunctate; antennæ and legs, except the coxæ and the femora at the middle, honey-yellow or pale brownish yellow; mouth-parts yellowish. Head transverse, deeply impressed anteriorly on the frons, the vertex therefore thin antero-posteriorly. Thorax short, oval, the collar very short, scarcely visible from above; the mesonotum smooth, broader than long, with the parapsidal furrows distinct, the median grooved line very faint; the scutellum convex, with two grooved lines; the metathorax very short, smooth. Wings hyaline, fringed; the hind wings lanceolate, acutely pointed at tips. Abdomen conic-ovate, pointed at tip, depressed above, convex beneath, and æneous black.

Flagellum clavate, pubescent, about twice as long as the scape; the funicle-joints submoniliform; the club stout, fusiform.

Hab. St. Vincent.

Described from two female specimens. The species is distinguished from the others by its smaller size, colour of antennæ, and the pointed hind wings.

TETRASTICHUS BASILARIS, sp. n.

♀. Length 1·5 to 2 millim. Black, shining, with a slight æneous tinge; head below the antennæ and the eyes piceous or pale ferruginous; scape, pedicel, a spot at base of abdomen, and the legs yellowish or whitish, the coxæ black, the femora sometimes dusky toward base. The face has two rows of punctures between the facial impression and the eyes; the thorax is faintly alutaceous; the collar distinct, rounded before and with a row of punctures along the posterior margin; mesoscutum with a single row of punctures along the parapsidal furrows. Wings hyaline pubescent, the venation pallid or pale brownish yellow. Abdomen conic-ovate or conically produced, longer than the head and thorax together.

Flagellum clavate, two and a half times as long as the scape; the funicle-joints nearly twice as long as thick, the club stouter, three-jointed.

Hab. St. Vincent.

Described from 50 female specimens.

TETRASTICHUS FASCIATUS, sp. n.

♂ ♀. Length 1·5 to 2 millim. Brownish yellow, smooth, impunctured; stemmaticum, flagellum, excluding the pedicel, eyes, grooved lines on thorax, sometimes the sides of metathorax, and the apical margins of the abdominal segments dark brown; the middle of abdomen sometimes wholly brown; scape, pedicel, and legs pale yellowish. The space between the eye and the facial impression smooth, or at the most with only a few punctures; pronotum short, rounded before; mesoscutum longer than wide, with some punctures along the parapsidal furrows; metathorax very short, abrupt, with a delicate median carina. Wings hyaline, pubescent. Abdomen conically produced, a little longer than the head and thorax united, with a style-like tip, the ovipositor being slightly exserted.

The female flagellum is clavate; the funicle-joints 1 and 2 nearly twice as long as thick, the third slightly shorter and stouter; while the club is ovate, 3-jointed, and stouter than the last funicle-joint. In the male the stemmaticum, occiput, a broad median band on thorax, metathorax, and abdomen are brownish black; the flagellum is long, filiform, pilose, with the funicle-joints, after the first, about three times as long as thick, the first joint being moniliform; while the abdomen is oblong-oval, not quite as long as the thorax.

Hab. St. Vincent.

Described from one male and 14 female specimens.

TETRASTICHUS PUNCTIFRONS, sp. n.

♀. Length 2·2 millim. Very close to *T. fasciatus*, but the head, except the face below the antennæ and the eyes, is distinctly metallic or æneous, the frons being closely punctate with thimble-like punctures; the occiput and thorax faintly shagreened; the median furrow of the mesoscutum distinct, but not so deeply and sharply defined, the punctures along the lateral margins large and distinct; while the antennæ, except the club, are pale brownish yellow.

Hab. St. Vincent.

Described from two female specimens.

PENTASTICHUS, gen. nov.

Similar to *Tetrastichus*, Haliday, and differing only in antennal characters as follows:—

In both sexes the antennæ are short, clavate, 8-jointed (without a ring-joint), pubescent, the joints moniliform, the pedicel being as long as the first two funicle-joints united; club stout, fusiform; scape slender, subclavate, inserted below the middle of the face, a little below an imaginary line drawn from the base of each eye. Frons deeply impressed; the anterior ocellus situated in the furrow, the lateral ocelli closer to the front ocellus than to the eye-margin. Thorax short, oval or almost round; the mesonotum about twice as wide as long, with three grooved lines; the scutellum semicircular, convex, with two grooved lines; metathorax very short, rounded. Wings broad, well fringed, with the venation as in *Tetrastichus*. Abdomen ovate, sessile or subsessile; the first and second body-segments the longest, about equal, the following shorter.

PENTASTICHUS XANTHOPUS, sp. n.

♂ ♀. Length 0·8 to 1 millim. Æneous black, smooth, impunctured; antennæ and legs lemon-yellow; wings hyaline, ciliated; abdomen ovate in female, pointed at apex, and as long as the head and thorax united; in male rounded at apex, scarcely as long as the thorax.

Hab. St. Vincent.

Described from two male and four female specimens.

Report on the Parasitic Cynipidæ, *part of the* Braconidæ, *the* Ichneumonidæ, *the* Proctotrypidæ, *and part of the* Chalcididæ.—PART III. By WILLIAM H. ASHMEAD.

Family PROCTOTRYPIDÆ.

Subfamily BETHYLINÆ.

EPYRIS, *Westwood*.

Two species, both males, may be distinguished as follows:—

Mesonotal furrows distinct.

Anterior coxæ and hind coxæ and femora black or piceous, rest of the legs brownish yellow; scape and pedicel yellow, the pedicel small, rounded; flagellum brown, the joints at least twice as long as thick .... *E. insularis*, sp. n.

Mesonotal furrows almost obliterated, with only slight traces anteriorly.

Legs, including coxæ, rufous, the tarsi paler; antennæ brown, fuscous or black toward tips; pedicel more than twice as long as thick, the joints of the flagellum fully thrice as long as thick. *E. incertus*, sp. n.

EPYRIS INSULARIS, sp. n.

♂. Length $2\frac{1}{2}$ millim. Black, shining, densely and very finely punctulate, covered with a sparse pubescence; mandibles, scape and pedicel, tegulæ and legs, except anterior coxæ and the hind coxæ, and sometimes the posterior femora, which are black or fuscous, brownish yellow. Eyes hairy. The mandibles are curved and rather slender, not broadened at tips, the tips truncate and with five minute teeth. Antennæ 13-jointed, filiform, acuminate towards tips, extending to the middle of the abdomen; flagellum fuscous, the pedicel very small, rounded, the first flagellar joint a little longer than the second, thrice as long as thick, the following twice as long as thick. The dorsum of the pronotum is trapezoidal, anteriorly and along the sides distinctly margined; mesonotum longer than the dorsum of the pronotum, with two distinct furrows and a grooved line on the scapulæ; scutellum with a furrow across the base; metathorax quadrate, the apex abruptly truncate, the sides and the truncature finely striated; the dorsum is margined along the sides and at apex, with a medial carina extending on to the truncature, its surface very finely transversely striated. Wings subhyaline, pubescent, the nerves brown; the transverse medial nervure is curved outwardly. Abdomen scarcely as long as the thorax, black, polished, sparsely pubescent, especially towards the tip; the third segment is twice as long as the fourth.

Hab. St. Vincent.

Described from four specimens.

EPYRIS INCERTUS, sp. n.

♂. Length $2\frac{1}{2}$ millim. Black, shining, very finely microscopically punctate, the surface appearing almost smooth, sparsely pubescent; mandibles, scape and base of flagellum, and legs, including all coxæ, brownish yellow. Eyes faintly pubescent or almost bare. The mandibles are closely folded under the overlapping labrum, and the number of teeth cannot be made out, but the outer tooth is long and acute. Antennæ 13-jointed, nearly as long as the body, cylindrical, pubescent, the flagellum being fuscous or black towards the tip; the pedicel is fully twice

as long as thick; first flagellar joint a little longer than the pedicel and slightly stouter than the second or the third; the joints beyond are all longer than the first and a little more than thrice as long as thick. The dorsum of the pronotum is a little longer than the mesonotum, margined anteriorly only, the sides rounded; mesonotum with slight traces of the parapsidal furrows anteriorly; scutellum with a transverse furrow at base; metathorax quadrate; the truncature and sides striate; the dorsum has a medial carina that extends only to the upper edge of the truncature, and with a short carina on each side at base, its surface being finely transversely striate. Wings hyaline or subhyaline, pubescent, the venation brown; the transverse medial nervure is oblique, curved outwardly. Abdomen polished black, the third segment the longest, not more than one third longer than the fourth.

Hab. St. Vincent.

Described from five specimens. The absence of distinct mesonotal furrows causes doubt in my mind as to its being a genuine *Epyris*.

ISOBRACHIUM, *Förster*.

The two species recognized in this genus may be thus distinguished:—

Mesonotal furrows indicated only anteriorly .... 2.
Mesonotal furrows complete.
Metathorax finely rugulose; legs yellowish white; flagellum fuscous or brown; first flagellar joint four times as long as the pedicel and a little longer than the second, the joints beyond thrice as long as thick .... *I. collinum*, sp. n.
2. Metathorax finely sculptured, the sides almost smooth.
Legs yellowish white; flagellum fuscous; pedicel rounded, not half the length of the first flagellar joint, the joints beyond the second two and a half times as long as thick .... *I. albipes*, sp. n.

ISOBRACHIUM COLLINUM, sp. n.

♂. Length 2 to 3½ millim. Black, shining, with sparse, distinct punctures; mandibles and antennæ pale ferruginous, the latter fuscous towards the apex; the depression above on collar usually pale or yellowish; legs, including coxæ, yellowish white or pale honey-yellow. Head across the eyes fully as wide as long; the eyes prominent, faintly pubescent. Mandibles broadened at tips, 5-dentate, the outer tooth long, acute, the second a little

shorter, the three following very small, about equal. Antennæ 13-jointed, filiform, tapering toward tips, extending to the base of the metathorax; scape curved, clavate, the length of the eye; pedicel small, rounded; first flagellar joint longer than the second, three and a half times as long as thick, the following joints thrice as long as thick. Pronotum finely transversely striated or closely minutely punctulate, the depression in collar above usually yellowish, rarely entirely black, the posterior margin tinged with piceous. Mesonotum with two distinct furrows. Scutellum with a profound fovea at base. Metathorax twice as long as wide, roundedly truncate posteriorly, dorsally rugulose, with an indistinct median carina and carinated along the superior edges of the sides. Tegulæ white or yellowish. Wings subfuscous, pubescent, the venation brown; the transverse medial nervure is oblique, and there is a more or less distinct, rhomboidal discoidal cell; the radial vein is very long. Abdomen oblong-oval, depressed, subpetiolated, black or dark piceous, banded or tinged with rufous.

Hab. St. Vincent.

Described from three specimens.

Isobrachium albipes, sp. n.

♂. Length $2\frac{1}{5}$ millim. Black, shining, at the most very faintly microscopically punctulate; mandibles and antennæ brown, the latter fuscous toward the tips; legs pale, whitish yellow or honey-yellow. The mandibles are broadened and truncate at apex, the two outer teeth acute, followed by three or four minute, blunt denticulations. Antennæ 13-jointed, extending to base of abdomen; pedicel very small, rounded, less than half the length of the first flagellar joint; the first flagellar joint about thrice as long as thick, the following two and a half times as long as thick. Thorax elongate, the prothorax triangular, a little longer than the mesonotum, the latter with traces of the furrows only anteriorly. Scutellum with a transverse fovea at base. Metathorax twice as long as wide, finely, faintly, transversely rugulose, the truncature rounded off, not margined above. Wings subhyaline, the venation brown; the transverse medial nervure is oblique, and the discoidal cell is only partially defined. Abdomen oblong-oval, depressed, more or less tinged with piceous.

Hab. St. Vincent.

Described from four specimens, captured at from 1000 to 2000 feet altitude.

DISSOMPHALUS, *Ashmead.*

This genus is allied to *Isobrachium*, Förster, and is described in my 'Monograph of the North-American Proctotrypidæ.' As the work has not yet appeared, I give here the essential characters for the recognition of the genus:—

Maxillary palpi 4-jointed; labial palpi 3-jointed. Mandibles 3-dentate. Antennæ 13-jointed, filiform, submoniliform, the first flagellar joint always smaller than the second, the joints beyond submoniliform. Mesonotum with or without furrows. Wings with two basal cells of an equal length; the transverse medial nervure straight; parastigma not developed; the stigma oblong-quadrate, the radial vein very long. Legs slender, the femora not much swollen. Abdomen oblong-oval or oval, depressed, subpetiolate; the second segment is always much longer than the third, and bears two warty-like tubercles or nipples, which are variously situated, often placed in a fovea or surrounded by a grooved line.

The two warty-like tubercles or nipples, on the second abdominal segment, are a unique character, and with the other characters mentioned will readily distinguish it from all other genera in the *Bethylinæ*.

The four species from St. Vincent may be thus tabulated:—

Mesonotal furrows wanting or with only traces anteriorly . . . . 2.

Mesonotal furrows complete, distinct.
Metathorax rugose, with a medial carina.
Transverse medial nervure straight.
Legs reddish yellow.
Second abdominal segment with two hairy tubercles in foveæ towards the base, widely separated; flagellum fuscous towards the tip, the pedicel oval, larger than the first flagellar joint, the second and the joints beyond longer than the first, about one and a half times as long as thick. *D. tuberculatus*, sp.

Metathorax almost smooth above, the sides and face of the truncature finely sculptured.
Legs honey-yellow.
Second abdominal segment with two tubercles close together; flagellum fuscous, the pedicel larger than the

first flagellar joint, the joints beyond quadrate, a little longer towards the tip .... *D. bisulcus*, sp. n.

2. Polished, impunctured; legs, scape, and pedicel honey-yellow; the second abdominal segment with the tubercles widely separated, placed near the lateral margin.
   Flagellum filiform, submoniliform, the first flagellar joint very small.
      Transverse medial nervure nearly straight, slightly curved at tip.
         Flagellar joints after the first scarcely longer than thick .... *D. confusus*, sp. n.
      Transverse medial nervure straight.
         Flagellar joints after the first twice as long as thick .... *D. politus*, sp. n.

DISSOMPHALUS TUBERCULATUS, sp. n.

♂. Length $2\frac{1}{2}$ millim. Polished black, shining, very faintly microscopically punctulate, the head with some larger scattered punctures. Mandibles and antennæ pale ferruginous, the latter fuscous towards tips. Legs reddish yellow. Head as broad as long; the eyes prominent, oblong oval, bare. Antennæ 13-jointed, filiform, extending to the base of the metathorax, covered with a short pubescence; scape slightly curved, two thirds the length of the eye; pedicel oval, a little longer than the first flagellar joint; the second flagellar joint and the joints beyond longer than the first, about one and a half times as long as thick. Pronotum contracted anteriorly into a rounded neck, the contracted portion finely transversely striated, the posterior portion very short, about one third the length of the mesonotum; mesonotum with two distinct parapsidal furrows and a grooved line on the scapulæ. Scutellum with a long transverse furrow at base. Metathorax scarcely longer than wide, roundedly truncate posteriorly, coarsely rugose, with a medial carina. Tegulæ yellowish. Wings subhyaline, pubescent, the venation brown; the transverse medial nervure is straight, and there are indications of a discoidal cell. Abdomen oval, depressed, subpetiolate, polished black; the suture between the first and second segments is very strongly arcuate; the second segment is fully twice as long as the third and bears two, widely separated, rounded, hairy nipples or tubercles, in foveæ below its middle; the third and following segments about of an equal length.

Hab. St. Vincent.

Described from six specimens.

DISSOMPHALUS BISULCUS, sp. n.

♂. Length 2 millim. Black, shining; prothorax very faintly and finely punctulate; metathorax very finely sculptured, the apex of the dorsum nearly smooth, its base with traces of two or three carinæ; sides and truncature bounded by a carina. Mesonotum with two distinct furrows. Scutellum with a transverse impressed line at base. Mesopleura with a crenate furrow across the middle. Antennæ 13-jointed, fuscous, yellowish at base, the pedicel longer than the first flagellar joint, the joints beyond quadrate, a little longer towards the tip of the flagellum. Wings hyaline, pubescent, the venation brown; the transverse medial nervure is straight, the discoidal cell indistinct and incomplete. Legs honey-yellow. Abdomen oblong-oval, smooth, shining; the two nipples on the second segment placed a little below the middle and close together, almost touching each other.

Hab. St. Vincent.

Described from three specimens.

DISSOMPHALUS CONFUSUS, sp. n.

♂. Length $1\frac{4}{5}$ millim. Polished black, impunctured; the metathorax very faintly punctulate, with a delicate medial carina towards base. Scape, pedicel, and legs honey-yellow or pale brownish yellow, the flagellum fuscous. Antennæ 13-jointed, filiform, submoniliform, extending slightly behind the tegulæ; the scape is more than four times as long as the pedicel, curved, and a little incrassated towards the tip; pedicel twice as long as the first funicle-joint; the first funicle-joint is the smallest, the following submoniliform, scarcely longer than thick. Prothorax triangular, about as long as the mesonotum, the latter with only slight traces of the parapsidal furrows anteriorly. Scutellum with a transverse furrow at base. Mesopleura with a curved furrow across the middle. Wings hyaline, the venation brown, the transverse medial nervure nearly straight, being very slightly curved inwardly at the apex or hind angle of the basal cell. Abdomen oblong-oval, depressed, black, shining, subpetiolate, the second segment not much longer than the third, with the two nipples placed wide apart towards the lateral margins.

Hab. St. Vincent.

Described from a single specimen taken at an altitude of 1500 feet.

DISSOMPHALUS POLITUS, sp. n.

♂. Length $1\frac{4}{5}$ millim. Polished black, impunctured; metathorax roundedly truncate behind, polished, with a dorsal medial carina and very faintly sculptured at base. Scape, pedicel, and legs honey-yellow, the flagellum brown or fuscous. Antennæ 13-jointed, filiform, extending to the base of the metathorax; scape more than four times as long as the pedicel; the pedicel oval, a little longer than the first funicle-joint; the first funicle-joint the shortest, the joints beyond the second about twice as long as thick, the last thrice as long. Mesonotum without a trace of a furrow, or so faint as to be discernible only in a certain light. Wings hyaline, very slightly tinged, the venation brown; the transverse medial nervure is straight, the discoidal cell indistinctly defined. Abdomen oblong-oval, depressed, black or with a piceous tinge, the second segment longer than the third, with two minute nipples, widely separated, and placed near the lateral basal angles.

Hab. St. Vincent.

Described from two specimens captured at 1500 feet altitude.

GONIOZUS, *Förster*.

Three distinct species in this genus are in the collection and may be thus tabulated:—

The backward-directed branch of the basal nervure prolonged, joining the apex of the transverse medial nervure, and forming a small, closed, subtriangular discoidal cell.
- Coxæ and femora black; tibiæ and tarsi honey-yellow .... *G. nigrifemur*, sp. n.
- Coxæ and legs entirely honey-yellow ...... *G. Sancti-Vincenti*, sp. n.

The backward-directed branch of the basal nervure ending abruptly, and not forming a small discoidal cell.
- Coxæ and femora black; trochanters, tibiæ, and tarsi honey-yellow .... *G. incompletus*, sp. n.

GONIOZUS NIGRIFEMUR, sp. n.

♀. Length 2 to $2\frac{1}{2}$ millim. Polished black, at most faintly indistinctly punctate, except the head, which exhibits a few

scattered punctures, and the sides and truncature of the metathorax, which are finely minutely sculptured. Antennæ 13-jointed, brownish yellow, hardly longer than the oblong head, moniliform, tapering at tips, the flagellar joints a little longer than wide, the first joint the smallest. Scutellum without a transverse furrow or fovea at base, separated from the mesonotum only by a delicate straight impressed line. Mesopleura with a round fovea at the middle. Dorsum of metathorax polished, without carinæ. Wings hyaline, the costa, parastigma, and stigma piceous, the nervures pale; the branch of the basal nervure curved backwards and joining the transverse medial nervure near its apex, forming a small subtriangular discoidal cellule. Legs black, the tibiæ and tarsi honey-yellow.

Hab. St. Vincent.

Described from two specimens.

GONIOZUS SANCTI-VINCENTI, sp. n.

♀. Length $1\frac{1}{2}$ to $1\frac{4}{5}$ millim. Polished black; the head and prothorax very finely, faintly, closely punctulate; antennæ and legs, including coxæ, wholly honey-yellow. The joints of the flagellum, after the first, are moniliform, fully as long as wide; otherwise, except in the colour of the legs, it agrees with *G. nigrifemur*.

Hab. St. Vincent.

Described from six specimens.

GONIOZUS INCOMPLETUS, sp. n.

♀. Length $2\frac{1}{5}$ millim. Polished black; the head and thorax very finely, faintly punctulate; mandibles, antennæ, except tips, trochanters, tibiæ, and tarsi honey-yellow; rest of the legs black. The antennæ are a little less than twice as long as the head, the flagellar joints, after the first, distinctly longer than wide. Wings hyaline; costa, parastigma, and stigma dark brown, the veins hyaline; the branch of the basal nervure ending abruptly, not curving backwards and forming no discoidal cell; otherwise it resembles *G. nigrifemur*.

Hab. St. Vincent.

Described from a single specimen.

Subfamily Dryininæ.

Labeo, *Haliday*.

The collection represents two distinct species in this genus, although they are closely related and difficult to separate.

The following characters may, however, be used to separate them:—

Black, shining; all coxæ black, the anterior femora, more or less, middle femora and posterior femora and tibiæ brown or fuscous, trochanters, knees, and tarsi pale or whitish.

Antennæ not extending beyond the metathorax; the scape and pedicel nearly of an equal length; the first flagellar joint twice as long as the pedicel, the following joints very slightly shorter, thrice as long as thick; vertex finely punctulate .... *L. Sancti-Vincenti*, [sp. n.

Black, shining; coxæ and legs pale, the middle and posterior coxæ dusky basally, their femora towards base fuscous.

Antennæ extending to the middle of abdomen; the scape distinctly longer than the pedicel; the first flagellar joint nearly thrice as long as the pedicel, the second and third joints fully as long as the first, the following four times as long as thick; vertex smooth, not finely punctulate........ *L. simulans*, sp. n.

Labeo Sancti-Vincenti, sp. n.

♂. Length $1\frac{3}{5}$ millim. Black, shining, sparsely covered with a short, whitish pubescence. Head shining, but finely, minutely punctulate. Ocelli red. Eyes hairy. Mandibles and palpi white. Antennæ 10-jointed, fuscous, not extending beyond the tip of metathorax; scape and pedicel oval, about equal; first flagellar joint twice as long as the pedicel, the following very slightly shorter, thrice as long as thick. Thorax with two furrows converging posteriorly. Mesopleura with a transverse furrow across the disk. Metathorax rounded off posteriorly, finely sculptured, opaque. Coxæ black or piceous; legs brown, all trochanters, tips of anterior femora and their tibiæ, middle of posterior knees, and all tarsi pale or whitish. Tegulæ yellowish white. Wings hyaline, the stigma brown, the veins hyaline.

Abdomen as long as the thorax, black, more or less tinged with piceous.

Hab. St. Vincent.

Described from three specimens.

LABEO SIMULANS, sp. n.

♂. Length $1\frac{4}{5}$ millim. Black, shining, sparsely pubescent. Head impunctured, shining, or at the most with a few scattered punctures. Ocelli pale. Mandibles and palpi white. Antennæ 10-jointed, fuscous, extending to the middle of the abdomen; scape longer than the pedicel; first flagellar joint more than twice as long as the pedicel, the second and third joints as long as the first, the following slightly shorter, but fully four times as long as thick. Thorax smooth, shining, with two furrows converging and almost meeting at the base of the scutellum. Mesopleura faintly, sparsely punctate, with a grooved line across the middle. Metathorax shining, finely, closely punctured or sculptured. Legs pale; middle and posterior coxæ basally and their femora slightly dusky. Wings hyaline, including the stigma and venation. Abdomen black, piceous towards the base.

Hab. St. Vincent.

Described from two specimens.

Subfamily CERAPHRONINÆ.

CERAPHRON, *Jurine*.

This group is poorly represented in the collection, but six specimens in all having been taken. All belong to the genus *Ceraphron*, and represent four distinct species, which may be separated as follows:—

Mesonotum with a distinct medial grooved line	2.
Mesonotum not grooved, or with only a trace of the groove anteriorly or posteriorly.	
Wings fuliginous or subfuscous; scape, pedicel, first flagellar joint, and the legs brownish yellow; rest of the flagellum black or fuscous.	
Female with the third and fourth flagellar joints longer than wide	*C. fummipennis*, sp. n.
Female with the third and fourth flagellar joints wider than long	*C. Sancti-Vincenti*, sp. n.

2. Wings fuscous.
 Female: scape and pedicel brown, the flagellum black; legs reddish yellow.
  First flagellar joint not longer than the pedicel, the second joint half the length of the first, the third and fourth quadrate .... *C. solitarius,* sp. n.

Wings hyaline, scarcely tinged.
 Female: scape, pedicel, and legs honey-yellow or pale brownish yellow.
  First flagellar joint shorter than the pedicel, the second, third, and fourth joints transverse, quadrate .... *C. meridionalis,* sp. n.

CERAPHRON FUMMIPENNIS, sp. n.

♀. Length 2 millim. Polished black, impunctured, at the most with a few minute scattered punctures. Antennæ 10-jointed, gradually incrassated toward tips, the scape, pedicel, and first flagellar joint brownish yellow, rest of the flagellum black or fuscous; the flagellum is two and a half times as long as the scape; the pedicel and first flagellar joint are elongate, the pedicel slightly the shorter; the flagellum from the second joint is gradually incrassated, the second, third, and fourth joints longer than thick; the terminal joint fusiform and the longest joint. Thorax smooth, shining, the mesonotum with only a faint trace of the furrow posteriorly. Metathorax exceedingly short, with a blunt tooth at base just behind the scutellum, and toothed posterior-lateral angles. Wings fuliginous, the venation dark brown; the radial vein long, curved, about thrice as long as the linear marginal vein. Abdomen one half longer than the head and thorax together, pointed at apex, highly polished, and with striæ at base.

The male, or what is supposed to be the male, is $1\frac{1}{2}$ millim. long, and differs from the female only in the antennæ; these are longer than the body, filiform, the flagellum black, the first and last joint slightly longer than the others, the intermediate joints being about thrice as long as thick.

Hab. St. Vincent.

Described from a male and a female specimen.

CERAPHRON SANCTI-VINCENTI, sp. n.

♀. Length $1\frac{3}{5}$ millim. Differs from the above in having paler subfuscous wings, the flagellum being only twice as long as the

scape, the four terminal joints only distinctly black; the second flagellar joint is distinctly larger than the pedicel, and neither of these joints are so long as in *C. fummipennis*; the third and fourth joints are wider than long; while the mesonotal groove, although delicate, is distinct for half the length of the mesonotum posteriorly.

Hab. St. Vincent.

Described from a single specimen.

CERAPHRON SOLITARIUS, sp. n.

♀. Length $2\frac{1}{2}$ millim. Resembles closely *C. fummipennis* in stature, colour of the wings, and sculpture; but the mesonotal furrow is distinct; there is a large V-shaped fovea on the mesopleuræ, not present in that species or the others; the legs are reddish yellow, pilose; the first flagellar joint is not longer than the pedicel, and both are relatively shorter than in *fummipennis*. These differences are sufficient to distinguish the species.

Hab. St. Vincent.

Described from a single specimen.

CERAPHRON MERIDIONALIS, sp. n.

♀. Length $1\frac{1}{5}$ millim. Polished black, impunctured; scape, pedicel, and legs honey-yellow or pale brownish yellow; flagellum fuscous, brownish towards the base. Antennæ 10-jointed, rather slender, subclavate; scape less than half the length of the flagellum, not extending to the ocelli, slender, cylindrical; pedicel distinctly longer and stouter than the first flagellar joint; the second, third, and fourth flagellar joints transverse quadrate. Thorax highly polished, with a distinct medial impressed line. Mesopleura smooth, shining, with a few faint striæ posteriorly. Wings hyaline, the radial vein long, strongly curved. Abdomen longer than the head and thorax together, the tip pointed, curving upwards.

Hab. St. Vincent.

Described from a single specimen.

Subfamily SCELIONINÆ.

Tribe i. TELENOMINI.

PHANURUS, *Thomson*.

PHANURUS AFFINIS, sp. n.

♀. Length $\frac{4}{5}$ millim. Black, shining, but very feebly minutely punctate; trochanters, knees, and tarsi white. Head quadrate,

the frons convex, smooth. Palpi pale. Antennæ 11-jointed; scape about one third the length of the flagellum; flagellum subclavate, gradually incrassated towards tip; pedicel longer and stouter than the first flagellar joint, its apical margin white; first flagellar joint a little longer than thick, the following submoniliform, the three or four preceding the ultimate transverse, the last ovate. Thorax oblong-oval, feebly punctate, very finely sericeous. Mesopleuræ with a smooth femoral furrow. Wings hyaline, pubescent, with rather long cilia at margins; venation pale brown, the marginal vein about half the length of the stigmal. Abdomen subfusiform, pointed, polished black, a little longer than the head and thorax together, the basal segment small, transverse, smooth, without striæ, the second very long, the following very short.

Hab. St. Vincent.

Described from two female specimens.

Comes nearest to *P. ovivorus*, Ashm., but that species is highly polished, impunctured, with more slender antennæ.

Telenomus, *Haliday*.

This genus, comprising the smallest species, and probably furnishing the greatest number of species in any one genus in the *Scelioninæ*, is well represented in the collection.

The following table will materially aid in determining the species:—

Table of Species.

Females.

Pedicel not longer than the first funicle-joint . 5.

Pedicel longer than the first funicle-joint.

  Head broadly transverse, much wider than thorax . . . . 2.

  Head quadrate, not or scarcely wider than thorax.

    Black.

      Coxæ pale or yellow.

        Legs pale yellow.

          Thorax microscopically punctate; scape fuscous; second abdominal segment twice as long as wide . *T. confusus*, sp. n.

        Legs brownish yellow; second abdo-

minal segment not twice as long as wide.

Thorax slightly impressed on disk .. *T. impressus*, sp. n.

Thorax not impressed, convex.

Thorax minutely wrinkled .... *T. difformis*, sp. n.

Thorax microscopically punctate.

Club stout, much shorter than scape *T. magniclavus*, sp. n.

Club slender, as long as the scape . *T. cubiceps*, sp. n.

Not entirely black (see male).

2. All coxæ pale or yellow .... 3.

All coxæ black.

Head nearly three times as wide as thick antero-posteriorly.

Antennæ brown, the scape pale basally; thorax sericeous; legs yellow, femora brown .... *T. medius*, sp. n.

3. Petiole yellow.

Head three and a half times as wide as thick antero-posteriorly.

Legs yellow .... *T. flavopetiolatus*, sp. n.

Petiole black.

Wings fuscous .... 4.

Wings hyaline, rarely faintly tinged.

Head two and a half times as wide as long.

Legs and antennæ, except club, yellow .... *T. meridionalis*, sp. n.

Head three times as wide as long.

Antennæ brown-black, the scape pale basally .... *T. pygmæus*, sp. n.

Head three and a half times as wide as long.

Thorax strigoso-scabrous, sericeous; legs pale honey-yellow ...... *T. scaber*, sp. n.

Thorax minutely punctate, sericeous; legs brownish yellow .... *T. Smithii*, sp. n.

Thorax polished, impunctured; legs pale yellow .... *T. flavicornis*, sp. n.

4. Head two and a half times as wide as long (see male).

5. Coxæ and legs yellow; wings hyaline.

Head three and a half times as wide as long; thorax minutely punctate.......... *T. Sancti-Vincenti*, sp. n.

Coxæ black.

Head two and a half times as wide as long; thorax finely punctate .... *T. nigrocoxalis*, sp. n.

Head four times as wide as long; head and thorax opaque, minutely closely punctulate. *T. megacephalus.*

Males.

Head transverse, much wider than the thorax.. 3.
Head quadrate or subquadrate, not or scarcely wider than thorax.
Thorax impressed .... *T. impressus.*
Thorax not impressed, convex.
Coxæ pale .... 2.
Coxæ black.
Femora and tibiæ piceous .... *T. monilicornis.*
2. Pedicel always shorter than the first flagellar joint.
Black; abdomen entirely black.
Legs pale yellow.
Head and thorax polished, impunctured.
Flagellar joints oval-moniliform .... *T. difformis.*
Head smooth, the thorax microscopically punctate.
Flagellum shorter than the body .... *T. magniclavus.*
Flagellum longer than the body .... *T. cubiceps.*
Sternum, metathorax, and petiole yellow. *T. pectoralis.*
3. Petiole yellow......................... *T. flavopetiolatus.*
Petiole black.
Wings fuscous; head two and a half times as wide as long.
Flagellar joints not very long.......... *T. fuscipennis.*
Wings subhyaline; head twice as wide as long.
Flagellar joints long .... *T. Sancti-Vincenti.*
Wings hyaline; head three and a half times as wide as long.
Antennæ yellow, flagellar joints moniliform .... *T. flavicornis.*
Antennæ, except toward base, brown, the basal flagellar joints elongate.. *T. Smithii.*

TELENOMUS MONILICORNIS, sp. n.

♂. Length $\frac{4}{5}$ millim. Black, shining; thorax with some faint microscopic punctures; head transverse quadrate, twice as wide as thick antero-posteriorly, smooth and shining; eyes pubescent; mandibles piceous. The antennæ are 12-jointed, filiform-moniliform, the scape one third the length of the flagellum, the second and third joints equal, a little longer than thick, the following

moniliform. Thorax oval, scarcely longer than wide, convex, with a microscopic pubescence. Legs black or piceous, the trochanters, base, and apex of the femora and tibiæ and the tarsi pale or yellowish. Wings hyaline, pubescent, with short cilia; the venation pale yellowish; the marginal vein about two thirds the length of the long oblique stigmal vein. Abdomen polished black, not longer than the thorax, depressed, subtruncate at apex.

Hab. St. Vincent.

Described from a single specimen.

TELENOMUS CONFUSUS, sp. n.

♀. Length $\frac{4}{5}$ millim. Black, shining; thorax feebly microscopically punctulate. Head transverse quadrate, highly polished. Eyes covered with a fine white pubescence. Mandibles pale. Antennæ 11-jointed, clavate; scape less than half the length of the flagellum, fuscous, yellow at base; flagellum black, the pedicel longer than the first funicle-joint, its apical margin yellowish; second funicle-joint slightly shorter than the first; the third and fourth very small; club stout, fusiform. Wings hyaline, ciliated, the venation pale brown, the stigmal vein very oblique, terminating in a small knob. Legs brownish yellow. Abdomen as long as the thorax, subtruncate at apex, black, shining, the petiole transverse, striated, the second segment about twice as long as wide at apex.

Hab. St. Vincent.

Described from a single specimen.

TELENOMUS IMPRESSUS, sp. n.

♂ ♀. Length $\frac{3}{5}$ millim. Black, shining; head quadrate, scarcely wider than the thorax, highly polished; thorax oval, always impressed dorsally; legs and antennæ, except the club which is brown, yellow. Antennæ 11-jointed; scape a little longer than half the length of the flagellum; pedicel twice as large as the first funicle-joint, the funicle-joints all very small; club 5-jointed, fusiform, the four basal joints transverse. Wings subhyaline, pubescent, ciliated. Abdomen oblong, as long as the thorax, polished black, the first segment finely striated, sometimes piceous, the second one and a half times as long as wide.

The male differs only in the antennæ; these are 12-jointed, filiform-moniliform, not quite as long as the body; the pedicel much longer than the first flagellar joint; the second and third

flagellar joints minute, the following to the last loosely articulated, transverse moniliform, the last twice as long as the penultimate.

Hab. St. Vincent.

Described from one male and six female specimens.

TELENOMUS DIFFORMIS, sp. n.

♂ ♀. Length $\frac{4}{5}$ millim. Polished black; head subquadrate, not more than twice as wide as thick antero-posteriorly; thorax ovoid, its dorsum alutaceous; legs honey-yellow. Antennæ 11-jointed, as long as the body, the scape and pedicel brownish yellow, the flagellum brown-black; pedicel longer than the first funicle-joint; the second and third funicle-joints shorter than the first; club 5-jointed, slender, the basal joint transverse, the second, third, and fourth a little longer than wide, the last ovate. Wings hyaline, ciliated, the venation brown, the marginal vein very short. Abdomen as long as the thorax, the second segment longer than wide at apex.

The male differs only in the antennæ, which are 12-jointed, filiform, submoniliform, longer than the body, the scape yellow, the flagellum fuscous; the first flagellar joint is longer than the pedicel; the second, third, and fourth shorter, more slender, and about of an equal length; remaining joints, except the last, oval-moniliform; covered with short white hairs.

Hab. St. Vincent.

Described from one male and one female specimen.

The left eye in the female is covered at base by the surface of the cheek, making it slightly smaller than the right.

TELENOMUS MAGNICLAVUS, sp. n.

♂ ♀. Length $\frac{4}{5}$ millim. Polished black; head quadrate, scarcely wider than the thorax; mandibles and palpi pale; legs pale brownish yellow. Antennæ 11-jointed, short, the flagellum only about one and a half times as long as the scape; the club very stout, much shorter than the scape, black; rest of the antennæ brownish yellow; the pedicel is a little longer than the first funicle-joint, the remaining joints about equal, moniliform; the first joint of the club is much narrower than the second, the third fully twice as wide as long, the last ovate. Wings hyaline, the venation pale brown, the marginal vein short. Abdomen a little longer than the thorax, narrowed at base.

The antennæ in the male are 12-jointed, filiform, hairy, a little nger than the body, pale brownish, the scape and pedicel llow; the pedicel is a little shorter than the first flagellar int; the first and second flagellar joints about equal, two and half times as long as thick; the third very little shorter, the llowing oval-moniliform, the two preceding the last round, the st conic. The head is quadrate, the eyes very large, occupying e whole side of the head. Otherwise it agrees with the female.

Hab. St. Vincent.

Described from one female and one male specimen.

TELENOMUS CUBICEPS, sp. n.

♀. Length $\frac{3}{5}$ millim. Black; head quadrate, highly polished, npunctured; thorax closely microscopically punctate, subopaque, ith a dull sericeous pubescence; legs brownish yellow; antennæ rown-black, the scape yellow. Antennæ 11-jointed, the scape ss than half the length of the flagellum; the pedicel not or carcely longer than the first funicle-joint; the first and second unicle-joints about equal, longer than thick, and a little shorter han the first; fourth joint small, rounded; the club is slender, usiform, 5-jointed, the three middle joints quadrate, the last ardly longer than the penultimate. Wings hyaline, ciliated, he venation brown, the marginal vein punctiform. Abdomen s long as the thorax, the second segment about twice as long s wide at apex.

The antennæ in the male are longer than the body, 12-jointed, black, hairy; the first flagellar joint about twice as long as the pedicel, the remaining joints, except the last, oval, about twice as long as thick, the last fusiform, nearly twice as long as the penultimate.

Hab. St. Vincent.

Described from one male and one female specimen.

TELENOMUS PECTORALIS, sp. n.

♂. Length $3\frac{1}{2}$ millim. Head and abdomen black, polished; thorax brownish piceous; metathorax, sternum, petiole, and legs yellow. The antennæ are 12-jointed, filiform-moniliform, the scape yellow, the flagellum brown; the first and second flagellar joints are about equal, longer than the pedicel; the joints after the third loosely articulated, round. Wings hyaline, the venation yellow, the marginal vein one third the length of the stigmal.

Abdomen, except the petiole, polished black, shorter than the thorax, the petiole yellow, striated, the second segment a little longer than wide at apex.

Hab. St. Vincent.

Described from a single specimen.

TELENOMUS MEDIUS, sp. n.

♀. Length $\frac{4}{5}$ millim. Black, shining; thorax sericeous; legs honey-yellow, the femora brownish, all coxæ black. The head is about thrice as wide as thick antero-posteriorly, the eyes with a white pubescence. Antennæ 11-jointed, brown, the scape yellowish towards the base, half the length of the flagellum; pedicel about twice as long as the first funicle-joint; second funicle-joint scarcely shorter than the first, both, however, a little longer than thick; third and fourth moniliform; club 5-jointed, the three middle joints transverse, about equal, the last conic. Wings hyaline, pubescent, the venation brown, the marginal vein half the length of the stigmal. Abdomen very little longer than the thorax, polished black, the first segment striate, the second scarcely longer than wide at apex.

Hab. St. Vincent.

Described from a single specimen.

TELENOMUS FLAVOPETIOLATUS, sp. n.

♂ ♀. Length $\frac{4}{5}$ millim. Polished black, impunctured; head three and a half times as wide as thick antero-posteriorly; scape, mandibles, and legs pale yellow; flagellum brown-black. Antennæ 11-jointed, the scape longer than half the length of the flagellum; pedicel stouter and longer than the first funicle-joint, yellowish at tip; first funicle-joint a little longer than thick; the three following not longer than thick, the last two transverse, small; club 5-jointed, slender, the first joint scarcely longer than the last joint of the funicle, the second larger, the third and fourth equal, quadrate, the last conic. Wings hyaline, ciliate, the venation brown, the marginal vein only one third the length of the stigmal. Abdomen very short, broadly oval, two thirds the length of the thorax, black, the petiole yellow, the third segment shorter than its width at apex.

The antennæ in the male are 12-jointed, filiform, pubescent, the pedicel small, rounded; the first flagellar joint stouter than the following and much larger than the pedicel; it as well as the following joint are longer than thick, those beyond the third

moniliform, loosely articulated, the last conic, a little longer than the penultimate.

Hab. St. Vincent.

Described from five female and seven male specimens.

TELENOMUS MERIDIONALIS, sp. n.

♀. Length $\frac{4}{5}$ millim. Polished black, the thorax sericeous. Head about two and a half times as long as thick antero-posteriorly. Antennæ 11-jointed, yellow, the 5-jointed club black; pedicel longer than the first funicle-joint, the latter longer than thick; second funicle-joint a little transverse, shorter than the first; third and fourth minute, rounded; club-joints, except the last, subquadrate, the last ovate. Wings hyaline, the venation yellow, the marginal vein about one third the length of the stigmal. Legs pale yellow. Abdomen not longer than the thorax, polished black, the first segment striate, the second longer than wide at apex.

Hab. St. Vincent.

Described from a single specimen.

TELENOMUS PYGMÆUS, sp. n.

♂ ♀. Length $\frac{1}{2}$ millim. Polished black, impunctured; head thrice as wide as thick antero-posteriorly; eyes covered with a white pubescence; antennæ and legs brown, the tarsi white. Antennæ 11-jointed; pedicel longer and stouter than the first funicle-joint, its apical margin yellow; second and third funicle-joints small, the fourth and fifth very minute, transverse; club fusiform, the joints, except the last, transverse quadrate. Wings hyaline, ciliated, the venation pale brown, the marginal vein about two thirds the length of the stigmal. Legs brown, the trochanters and tarsi white. Abdomen very little shorter than the thorax, black, polished, the second segment a little shorter than its width at apex.

The male antennæ are 12-jointed, brown, pubescent, the pedicel very slightly longer than the first flagellar joint, the second smaller than the first, the following to the last loosely joined, transverse moniliform, the last ovate, a little longer than the penultimate. Legs whitish yellow.

Hab. St. Vincent.

Described from a single specimen in both sexes.

TELENOMUS SCABER, sp. n.

♀. Length $1\frac{1}{5}$ millim. Head, scutellum, and abdomen polished

black, impunctured; thorax strigoso-scabrous, sericeous; metathorax rugoso-punctate. Head three and a half times as wide as thick antero-posteriorly. Mandibles yellow. Antennæ 11-jointed, the scape and funicle yellow, the club black; the scape is half as long as the flagellum; pedicel one third longer than the first funicle-joint; the second funicle-joint shorter than the first, third and fourth transverse, the fourth the wider; club 5-jointed, fusiform, the basal joint as wide as the second, the following two subequal in width, nearly twice as wide as long, the last conic. Wings hyaline, pubescent, the venation pale yellow, the marginal vein less than half the length of the stigmal. Legs, including coxæ, pale honey-yellow. Abdomen oval, as long as the thorax, the first segment striated, the second hardly longer than wide at apex.

Hab. St. Vincent.

Described from a single specimen. The sculpture of the thorax is quite distinct from all the other species, and will alone distinguish it.

Telenomus Smithii, sp. n.

♂ ♀. Length $\frac{4}{5}$ millim. Polished black, the thorax minutely punctate, sericeous. Head about three and a half times as wide as long. Mandibles pale. Antennæ 11-jointed, the scape longer than half the length of the flagellum, brown, the club black; pedicel one third longer than the first funicle-joint, yellow at tip; second funicle-joint shorter than the first, third and fourth very small, rounded, the fourth the smaller; club 5-jointed, the first joint narrower and shorter than the second, the second, third, and fourth quadrate, the second slightly the widest, the last conic. Wings hyaline, pubescent, the venation pale brown, the marginal vein punctiform. Legs, including coxæ, yellow or brownish yellow. Abdomen as long as the thorax, polished black, the first segment striate, the second a little longer than its width at the apex.

The male antennæ are 12-jointed, filiform, hairy, as long as the body; the scape, pedicel, and three basal joints of flagellum yellow, the remaining fuscous or dark brown; the scape is only about one fourth the length of the flagellum; pedicel small, rounded; the three basal joints of flagellum elongate, the first about twice as long as thick, the others longer, the third narrowed basally and a little curved; remaining joints to the last moniliform, subpedicellate, the last conic.

Hab. St. Vincent.

Described from one male and six female specimens.

TELENOMUS FLAVICORNIS, sp. n.

♂ ♀. Length ·80 millim. Polished black, impunctured. Head three and a half times as long as thick antero-posteriorly. Antennæ 11-jointed, brown, the scape beneath yellow; the flagellum is twice as long as the scape; pedicel a little longer than the first funicle-joint; the second a little longer than the first; third and fourth transverse moniliform, a little wider than the preceding joints; club fusiform, the first joint the shortest and narrowest, the second the longest and widest, quadrate, the third and fourth subequal, quadrate, the last conic. Wings hyaline, pubescent, the venation pale, the marginal vein punctiform. Legs pale yellow. Abdomen not longer than the thorax, polished black, the second segment scarcely longer than its width at apex.

The antennæ in the male are 12-jointed, yellow, very slightly dusky at tips, filiform-moniliform, a little longer than the body; the pedicel is shorter and not quite as thick as the first flagellar joint; the first and third flagellar joints about equal; the second a little longer; all the joints loosely articulated, hairy; the last conic, twice as long as the penultimate, the three or four preceding joints round.

Hab. St. Vincent.

Described from one male and one female specimen.

TELENOMUS FUSCIPENNIS, sp. n.

♂. Length $\frac{4}{5}$ millim. Polished black, impunctured. Head about two and a half times as wide as thick antero-posteriorly. Mandibles piceous. Antennæ 12-jointed, filiform, pubescent, a little longer than the body, black; the scape brownish yellow; the pedicel is shorter than the first flagellar joint, the latter the stoutest joint of all, twice as long as thick; the second the longest, fully thrice as long as thick; the two following subequal, shorter than the third; remaining joints, except the last, long oval, twice as long as thick; the last long, fusiform, about two and a half times as long as the penultimate. Wings fuscous, the venation brown, the marginal vein half as long as the stigmal. Legs brownish yellow. Abdomen polished black; the first segment striate, the second scarcely longer than its width at apex.

Hab. St. Vincent.

Described from a single specimen. In the fuscous-coloured

wings and the relative length of the antennal joints this species is quite distinct from all the others.

Telenomus Sancti-Vincenti, sp. n.

♂ ♀. Length 1 millim. Black, shining, the head and abdomen polished; the thorax minutely but distinctly punctate, sericeous. Head three and a half times as wide as thick antero-posteriorly. Mandibles pale rufous. Antennæ yellowish, the six terminal joints fuscous or black; the scape is longer than half the length of the flagellum; pedicel as long as the first funicle-joint but not so thick; second and third funicle-joints subequal, shorter than the first; fourth small, round, about half the length of the third, but narrower; club 5-jointed, rather slender, the last joint conic, the preceding joints very little wider than long. Wings hyaline, the venation pale, the marginal vein about two thirds the length of the stigmal. Legs brownish yellow. Abdomen not longer than the thorax, the second segment not or scarcely longer than wide at apex.

The head in what is taken to be the male of this species is only twice as wide as thick antero-posteriorly; the antennæ 12-jointed, filiform, pilose, much longer than the body, black, with the scape yellow; the pedicel is small, not quite half the length of the first flagellar joint; the flagellar joints are all long, cylindrical, the second being the longest joint, about four times as long as thick, the last fusiform; wings subfuscous.

Hab. St. Vincent.

Described from one female and one male specimen.

Telenomus nigrocoxalis, sp. n.

♀. Length about $\frac{4}{5}$ millim. Polished black, the thorax minutely punctate, sericeous. Head two and a half times as wide as long antero-posteriorly. Mandibles pale brown. Antennæ 11-jointed, brown, becoming black toward apex, the scape yellowish; the scape is longer than half the length of the flagellum; pedicel longer and thicker at the tip than the first funicle-joint, the following joints to the club subequal, the last rounded; club 5-jointed, rather slender, the first joint longer than wide, the three following quadrate, the last conic. Wings hyaline, pubescent, the venation pale brown, the marginal vein scarcely half the length of the stigmal. Legs brownish yellow, with all the coxæ black. Abdomen as long as the thorax, the first segment striated, the second a little longer than wide.

Hab. St. Vincent.

Described from a single specimen.

TELENOMUS MEGACEPHALUS, sp. n.

♀. Length $1\frac{1}{5}$ millim. Black, subopaque, the head and thorax closely minutely punctulate; abdomen highly polished. The head is unusually wide, fully four times as wide as thick antero-posteriorly. Antennæ 11-jointed, brownish yellow, the club black; the pedicel is longer than the first funicle-joint; second funicle-joint shorter than the first; third and fourth transverse, subquadrate, the fourth the wider; the first four joints of the club are quadrate, the last conic. Wings hyaline, pubescent, the venation pale brown, the marginal vein punctiform. Legs brownish yellow, the coxæ black. Abdomen broadly oval, not longer than the thorax, the first segment short, very wide, striated, the second segment wider than long.

Hab. St. Vincent.

Described from a single specimen.

The species is remarkable for the very broad head, in this respect approaching more closely to those species which are now included in my genus *Trissolcus*.

TRISSOLCUS, *Ashmead*.

TRISSOLCUS LATICEPS, sp. n.

♀. Length 1 millim. Black, subopaque, minutely closely punctulate; scape of antennæ and legs, except coxæ and the basal two-thirds of the femora which are black, reddish yellow; tarsi yellowish. Head very broad, about four times as wide as thick antero-posteriorly; the lateral ocelli a little away from the margin of the eye and connected with it by an oblique grooved line. Thorax with three abbreviated grooved lines posteriorly; the scutellum polished. Antennæ 11-jointed, the pedicel longer than the first flagellar joint, the last two funicle-joints small, rounded; club 5-jointed, the last joint conic, the other joints transverse quadrate, about twice as wide as long. Abdomen broadly oval, polished black, not longer than the thorax; the first segment striate, the second much wider than long. Wings subfuscous, the marginal vein short.

Hab. St. Vincent.

Described from four specimens.

Tribe ii. TELEASINI.

PROSACANTHA, *Nees.*

Of this extensive genus but three species, in the male sex, are represented in the collection, which may be separated as follows :—

Black, shining.	
Thorax with indications of furrows posteriorly . .	2.
Thorax entirely without furrows; legs brownish yellow; postscutellar spine very short.	
Antennæ only a little longer than the body, the flagellar joints from the fourth longer than the first, the first four times as long as thick.	
Abdominal segments 1 and 2 and base of 3 striated	*P. brevispina*, sp. n.
2. Legs brownish yellow.	
Middle tarsi and two-thirds of posterior tibiæ and their tarsi fuscous; antennæ nearly twice as long as the body, the flagellar joints all long, 7 or 8 times longer than thick; wings subfuscous.	*P. tibialis*, sp. n.
Legs reddish yellow.	
Antennæ much longer than the body, the flagellar joints about 5 times as long as thick; wings fuscous	*P. sublineata*, sp. n.

PROSACANTHA BREVISPINA, sp. n.

♂. Length $1\frac{1}{2}$ millim. Black, shining, the vertex and thorax faintly, sparsely punctulate; face highly polished, with striæ along the orbits. Antennæ 12-jointed, a little longer than the body, brown-black, the basal half of scape yellowish; the first flagellar joint is very slightly longer than the second, about four times as long as thick, the second and third subequal, the fourth as long as the first, all the following longer than the first. Scutellum polished. Postscutellum punctate, its spine very short, not longer than broad at base. Legs brownish yellow. Wings hyaline. Abdomen polished, the first and second segments and the third at base striated.

Hab. St. Vincent.

Described from two male specimens.

PROSACANTHA TIBIALIS, sp. n.

♂. Length $1\frac{1}{2}$ millim. Black, shining, the vertex and the thorax sparsely punctate, the face striate. Mandibles large, rufous. Antennæ 12-jointed, nearly twice as long as the body, black, the scape pale at base; the first flagellar joint is about seven times as long as thick, the third angulated, the following a little longer. Thorax with the parapsidal furrows slightly indicated posteriorly. Scutellum polished, punctate at base. Postscutellar spine long, acute, two and a half times as long as thick at base. Legs brownish yellow, the middle tarsi and two-thirds of posterior tibiæ and their tarsi fuscous; tarsi very long and slender, much longer than their tibiæ. Wings subfuscous. Abdomen polished, the first and second segments and most of the third longitudinally striated.

Hab. St. Vincent.

Described from six male specimens.

PROSACANTHA SUBLINEATA, sp. n.

♂. Length 1·6 millim. Black, shining; in sculpture and colour, except the legs are wholly reddish yellow, it agrees with *P. tibialis*; but the antennæ are shorter and stouter, the first flagellar joint being only five times as long as thick and a little shorter than the second; the postscutellar spine is a little longer, acute; while the striæ on the first and second abdominal segments are very coarse, the third exhibiting some faint striæ only at base.

Hab. St. Vincent.

Described from a single specimen.

ACOLOIDES, *Howard*.

This genus is parasitic on spiders' eggs. The three species recognized in the collection may be tabulated as follows:—

Not entirely yellow	2.
Entirely yellow; eyes, ocelli, and antennal club brown-black; head very broad. ♀	*A. ochraceus*, sp. n.
2. Head and thorax black.	
Abdomen, scape, and legs yellow, the femora dusky above; wings hyaline, with a fuscous streak beneath the tip of the stigmal vein. ♀	*A. fascipennis*, sp. n.
Subfuscous; the base of abdomen, scape, and legs yellow; antennæ moniliform. ♂	*A. subfuscus*, sp. n.

ACOLOIDES OCHRACEUS, sp. n.

♀. Length 1·5 millim. Honey-yellow or brownish yellow, feebly punctulate, the abdomen finely, longitudinally striate. Head large, very broad; the eyes purplish brown, bare; ocelli black. Antennæ with the flagellum fuscous; the club large, unjointed; the pedicel obconic, nearly as long as the first three funicle-joints united; the first funicle-joint very little longer than thick, the three following equal, transverse; club very large, fusiform, as long as the pedicel and funicle. Wings subhyaline, the nervures fuscous; the marginal vein punctiform, the stigmal long, thickened at base.

Hab. St. Vincent.

Described from a single specimen.

ACOLOIDES FASCIPENNIS, sp. n.

♀. Length 0·6 millim. Head and thorax black, subopaque, closely microscopically punctate; antennæ pale brown, tinged with fuscous; legs and abdomen brownish yellow. Wings hyaline, with a slight fuscous blotch beneath the tip of the stigmal vein, the nervures pale yellowish; the marginal vein punctiform, the stigmal long, ending in a little knob.

Hab. St. Vincent.

Described from a single specimen.

ACOLOIDES SUBFUSCUS, sp. n.

♂. Length 0·6 millim. Brownish, shining, faintly microscopically punctate, with a fine sericeous down; the scutellum and abdomen towards apex fuscous, the scutellum more distinctly punctate than the thorax; abdomen at base, scape, and legs brownish yellow; flagellum brown, filiform, submoniliform, the last joint ovate. Wings subfuscous, pubescent, with long cilia, and with a slight blotch beneath the stigmal vein.

Hab. St. Vincent.

Described from a single specimen.

Possibly this may prove to be the male of *A. fascipennis*.

Tribe iii. Scelionini.

As there are several species described in new genera, indicated in my 'Monograph of North-American Proctotrypidæ,' I give here a copy of the tables for their recognition.

Table of Genera.

Postmarginal vein wanting or never greatly developed, always shorter than the stigmal vein, the submarginal vein often never reaching the costa and terminating in a large stigma; the abdomen long, fusiform	4.
Postmarginal vein always greatly lengthened, the submarginal never terminating in a stigma.	
Basal vein wanting	3.
Basal vein present.	
First abdominal segment without a horn at base	2.
First abdominal segment with a horn at base.	
Marginal vein short; abdomen long, pointed fusiform, the first segment narrow, petioliform, the second and third nearly equal............................	*Caloteleia*, Westw.
Marginal vein long; abdomen long, linear or subfusiform, the first segment quadrate or subquadrate	*Baryconus*, Förster.
2. Abdomen long, pointed fusiform or linear, segments 2, 3, and 4 nearly equal.	
Mesonotum with two furrows.	
Metascutellum without a spine.	
Metanotum with no enclosed space at base.	
Marginal vein about twice the length of the stigmal.	
Mandibles 3-dentate	*Macroteleia*, Westw.
Mandibles 2-dentate	*Calliscelio*, Ashm.
Metanotum with a large, semicircular enclosed space at base.	
Marginal vein punctiform	*Chromoteleia*, Ashm.
Abdomen oblong-oval or fusiform, but not especially lengthened.	
Metascutellum spined.	
Mesonotum with two furrows.	
Mandibles 2-dentate; abdominal segments 1 and 2 equal in length, the third longer	*Opisthacantha*, Ashm.

Mesonotum without furrows.

Mandibles 2-dentate; segments 1 and 2 equal in length, the 3rd longer (*Opisthacantha*).

Mandibles 3-dentate; segments 2 and 3 equal in length, the 1st shorter ...... *Lapitha*, Ashm.

Metascutellum not spined, simple.

Marginal vein short, or not more than half the length of the stigmal, most frequently punctiform.

Mesonotum without furrows.

Head quadrate .... *Cacus*, Riley.

Mesonotum with two furrows.

Antennæ with a 6-jointed club .... *Anteris*, Förster.

Antennæ filiform, without a club .... *Apegus*, Förster.

3. Mesonotum with three distinct furrows.

Metascutellum with two erect teeth .... *Hoploteleia*, Ashm.

Mesonotum with two furrows.

Abdomen very long, fusiform or linear.

Metathorax unarmed; mandibles 3-dentate .... *Macroteleia*, Westw.

Abdomen not very long, ovate or oblong-oval.

Metathorax unarmed; mandibles 2-dentate .... *Anteris*, Förster.

Mesonotum without furrows.

Metascutellum spined (*Opisthacantha*).

Metascutellum simple.

Abdomen fusiform.

Abdominal segments strongly constricted; antennal club oval, 5-jointed ...... *Cremastobæus*, Ashm.

Abdomen broadly oval, sessile, the second segment usually a little the largest.... *Hadronotus*, Förster.

4. Submarginal vein not reaching the costa, knobbed .... *Bæoneura*, Förster.

Submarginal vein reaching the costa often by a thickened stigma.

Marginal vein very short, the postmarginal scarcely developed, or shorter than the stigmal.

Mesonotum with two furrows........... *Idris*, Förster.

Submarginal vein terminating in a thickened stigma.

Head without a frontal lamina or ledge; postmarginal vein never developed .... 5.

Head with a frontal lamina or ledge.
Scutellum quadrate, the posterior angles acute; postscutellum with a large erect spine .... *Acanthoscelio*, Ashm.
Scutellum and postscutellum simple, not spined .... *Sparasion*, Jurine.
5. Mesonotum with or without furrows.
Maxillary palpi short, 3-jointed............ *Scelio*, Latr.
Mesonotum with two distinct furrows.
Maxillary palpi long, 5-jointed .... *Sceliomorpha*, Ashm.

CALOTELEIA, *Westwood*.

This genus seems to be well represented in the West Indies and South America, and the several species recognized may be thus tabulated:—

Species pale.............................. 2.
Species black or æneous.
Mesonotal furrows present.
Head microscopically punctate; thorax smooth, impunctured; base of first abdominal segment, legs, and antennæ, except club, yellow; vertex narrow. ♀. *C. puncticeps*, sp. n.
Head and thorax, except centrally, coarsely punctate, æneous; legs and scape pale brown; vertex broad. ♂ ♀ .... *C. ænea*, sp. n.
Mesonotal furrows wanting.
Abdomen very long and pointed, in female with the lateral margins more or less yellow; legs pale yellowish; antennæ brown, the scape yellow. ♂ ♀ .... *C. elongata*, sp. n.
2. Mesonotal furrows wanting.
A basal nervure.
Honey-yellow, impunctured; abdominal segments 2, 3, and 4 banded with black at apex; eyes blue. ♂ ♀ .... *C. ocularis*, sp. n.
Brownish yellow, punctate; apex of abdomen, the 3rd segment and base of 4th, and the apex of horn black; the male with the base of the 2nd segment black .... *C. maculipennis*, sp. n.
No basal nervure.
Brownish yellow, coarsely punctate; apex of abdomen dusky; eyes and antennal club brown-black. ♂ ♀ .... *C. punctata*, sp. n.

CALOTELEIA PUNCTICEPS, sp. n.

♀. Length 1·2 millim. Polished black, the head on vertex and the abdomen finely punctate; antennæ, except the club, legs, and apical half of the petiole honey-yellow. Antennæ 12-jointed; the pedicel is longer than the first funicle-joint, the first and second funicle-joints subequal, the third smaller, the fourth very minute. Thorax polished, impunctured, with two furrows. Wings hyaline, the venation yellowish, the marginal vein punctiform, the stigmal very short. Abdomen fusiform, twice the length of the thorax, the first segment striate, the horn at apex polished black; the second and third segments nearly equal in length, their extreme apical edges smooth, polished.

Hab. St. Vincent.

Described from a single specimen.

CALOTELEIA ÆNEA, sp. n.

♂ ♀. Length 2·1 to 2·3 millim. Æneous black; head in female closely punctate, the cheeks alone smooth; thorax punctate, with two furrows, more closely punctured toward the sides, the mesonotum and scutellum having a smooth impunctured space down the centre; metathorax deeply emarginate behind; scape and legs pale brownish; first funicle-joint longer than the pedicel; second shorter; third and fourth small, transverse. Wings fuscous or subfuscous, hyaline at base; the marginal vein is about half the length of the stigmal.

In the male the head and thorax are smooth, impunctured; the petiole long, fluted; the second abdominal segment and the third and following, at the sides, longitudinally striate; the metathorax is finely rugose and armed with two erect spines; antennæ long, filiform, the joints loosely joined; the flagellum is black, the first joint the longest, much longer than the pedicel, more than four times as long as thick, the following joints, to the last, subequal, the third excised at base.

Hab. St. Vincent.

Described from one female and three male specimens.

CALOTELEIA ELONGATA, sp. n.

♀. Length 4 millim. Black, punctate; the abdomen along the sides yellow; legs pale, whitish yellow; antennæ, except club, brownish yellow. Mesonotum without furrows. Antennæ 12-jointed, the pedicel and first two funicle-joints elongated, the first one third longer than the second; third funicle-joint half the length of the second; fourth about half the length of the

third but shorter. Wings subfuscous, the venation brown-black; basal nervure distinct, originating from a fuscous cloud; marginal vein two thirds the length of the stigmal; stigmal vein slightly curved, terminating in a rounded stigma. Abdomen very long, pointed, about four times as long as the thorax, punctate, the first and second segments the longest, the first being slightly the longer, striate; horn not extending above the apex of scutellum.

♂. Length 3 to 3·2 millim. Differs from female in having the abdomen entirely black, without a basal horn, the first segment being shorter than the second and but slightly longer than the third, striate; the following segments punctate and lineated except toward the sides, the second with a central carina; the antennæ are very long, filiform, brown-black, with a reddish-yellow scape; the flagellar joints are all about of an equal length, cylindrical, about five times as long as thick.

Hab. St. Vincent.

Described from two female and eight male specimens.

CALOTELEIA OCULARIS, sp. n.

♂ ♀. Length 1·1 to 1·5 millim. Honey-yellow, polished, impunctured; in the female the club of antennæ, the second abdominal segment, and the apical half of the third and fourth segments are black; in the male the flagellum, apical half of the first, second, and third abdominal segments black. Eyes large, distinctly pale blue in both sexes. Wings subfuscous, with a fuscous cloud enclosing the basal nervure. Abdomen in female pointed, fusiform, about twice the length of the head and thorax together; the second segment two thirds the length of the third; the first segment striate, furnished with a horn at base that extends forwards before the apex of the scutellum, the horn being smooth and black at apex; the following segments are faintly aciculated, the second minutely granulated at the middle. Pedicel and second funicle-joint are about equal, very little longer than thick; the first funicle-joint is a little longer, about twice as long as thick; the third and fourth minute, transverse.

In the male the abdomen is but slightly longer than the head and thorax; antennæ filiform, dusky toward tips; the scape and pedicel yellow, the latter scarcely half the length of the first flagellar joint; first and second flagellar joints about equal, shorter than the following.

Hab. St. Vincent.

Described from four female and two male specimens.

CALOTELEIA MACULIPENNIS, sp. n.

♂ ♀. Length 2·5 to 3 millim. Brownish yellow, moderately coarsely punctate; head transverse; thorax without furrows. The eyes, club of antennæ, metapleura, apex of horn, third abdominal segment, the fourth at base, and the conical last segment black. In the male the flagellum is usually fuscous, and the base of the second abdominal segment is also black, otherwise it is coloured as in the female. Wings subhyaline, with a large smoky cloud across the disk of the wing beyond the stigmal vein; basal nervure present; marginal vein about three times as long as thick; stigmal slightly curved, ending in a knob. The antennæ in the female have the pedicel longer than the second funicle-joint, the first being longer than the pedicel, third very little longer than thick, fourth quadrate. In the male the antennæ are filiform, the joints about equal, the first flagellar joint being slightly the longest. Abdomen smooth, the first and second segments striate; the first and third segments are about equal, the second longer.

Hab. St. Vincent.

Described from one female and three male specimens.

CALOTELEIA PUNCTATA, sp. n.

♂ ♀. Length 2·1 to 2·5 millim. Brownish yellow, closely rather coarsely punctate; apex of abdomen fuscous; antennal club in female black. Postscutellum in both sexes armed with two erect teeth or tubercles. In the female the pedicel and the first funicle-joint are elongate, about equal in length, the second funicle-joint only slightly longer than thick, third and fourth moniliform; in the male the pedicel is less than half the length of the first flagellar joint, the second one third shorter than the first, the third and following joints a little longer than the second. Wings subfuscous; the marginal vein is about half the length of the shaft of the stigmal, the latter being knobbed; basal nervure wanting. Abdomen, except the first and second segments, polished, impunctured, the first and second striate, the second more finely striate than the first, and the longest segment, the first, a little shorter than the third.

Hab. St. Vincent.

Described from six male and nine female specimens.

Macroteleia, *Westwood.*

From rearings of a species in America we now know that this genus is parasitic on the eggs of the orthopterous genus *Orchilimum*, although it may also prove to infest the eggs of other Locustidæ.

The species from St. Vincent may be thus tabulated :—

Mesonotal furrows complete.
  Species not entirely black .... 2.
  Species entirely black, punctate.
    Abdomen very long, $3\frac{1}{2}$ times as long as the head and thorax united; middle lobe of mesonotum with a median carina; legs and antennæ, except the club, brownish yellow or yellow. ♀ .... *M. carinata*, sp. n.
    Abdomen only about $2\frac{1}{2}$ times as long as the head and thorax united; middle lobe of mesonotum not carinate; legs and antennæ, except club, brownish yellow or honey-yellow .... *M. Sancti-Vincenti*, sp. n.
2. Abdomen, except sometimes the tip, rufous; scape and legs brownish yellow; scutellum with a delicate median carina............ *M. erythrogaster*, sp. n.

Macroteleia carinata, sp. n.

♀. Length 5·1 millim. Black, punctate; head quadrate; antennæ brownish yellow or pale rufous, the club black. Pedicel and first funicle-joint lengthened, the latter the longer; second funicle-joint scarcely half the length of the first; third very slightly shorter; fourth transverse-quadrate. Thorax with two furrows, the middle lobe with a central carina. Legs, including coxæ, pale rufous or brownish yellow. Wings subfuscous, the marginal vein once and a half as long as the stigmal, the latter oblique, knobbed; basal nervure wanting. Abdomen very long and pointed, $3\frac{1}{2}$ times as long as the head and thorax together, punctate and faintly aciculated, the first and second segments striate; segments 1, 2, and 3 with dorsal longitudinal carinæ towards the sides; the first segment is about half the length of the second, the following being about equal in length.

Hab. St. Vincent.

Described from a single specimen. The carinæ on the middle mesonotal lobe and the basal abdominal segments are unique in the genus, and readily distinguish the species.

MACROTELEIA SANCTI-VINCENTI, sp. n.

♀. Length 3 to 3·1 millim. Black, punctate; antennæ, except the club (rarely the funicle), and legs brownish yellow or pale rufous. Thorax with two furrows; no carina on the middle lobe. Wings hyaline, the venation pale brown, the marginal not quite twice as long as the stigmal, the basal nervure wanting; tegulæ blackish. Abdomen fusiform, $2\frac{1}{2}$ times as long as the head and thorax together, closely punctate; the second and third segments are about equal, not quite twice as long as the first; fourth a little shorter; fifth shorter than the fourth; sixth subcompressed, longer than the fourth.

Hab. St. Vincent.

Described from five specimens.

MACROTELEIA ERYTHROGASTER, sp. n.

♀. Length 3 to 3·2 millim. Agrees closely, structurally, with *M. Sancti-Vincenti*, except that the abdomen, with the exception of the compressed conical last segment which is black, is wholly rufous, the wings with a fuscous tinge, the marginal vein being only once and a half as long as the stigmal, while the scutellum has a slight median carina.

Hab. St. Vincent.

Described from eight specimens. Distinguished at once by the colour of the abdomen and by the keeled scutellum.

CALLISCELIO, *Ashmead.*

CALLISCELIO LATICINCTUS, sp. n.

♀. Length 2·5 millim. Head black; face, clypeus, mandibles, and palpi pale; thorax rufous or brown, the metathorax black; legs yellowish, the posterior coxæ and femora obfuscated above. Abdomen fusiform, much longer than the head and thorax together, piceous brown, the basal one-third of the second segment and basal half of third yellow; petiole, apical two-thirds of second segment, and the last three segments black; the petiole is nearly three times as long as thick, of a uniform width throughout, and longitudinally striate; the second segment is the longest, one half longer than the first, broadened at apex to three times its width at base, its basal half longitudinally aciculated; the third two thirds the length of the second, the fourth two thirds the length of the third; fifth a little more than half the length of the fourth; sixth conical, about as long as the third. Head transverse, finely

punctate. Antennæ 12-jointed, brownish yellow, the club black; the first and second funicle-joints are long, cylindrical, subequal; the third two thirds the length of the second, stouter; the fourth about one half the length of third and thicker. Thorax with small sparse punctures. Wings fuscous, with the basal half and the apex hyaline; basal nervure distinct, the marginal three times as long as the oblique stigmal, the latter ending in a little knob; the postmarginal longer than the marginal.

Hab. St. Vincent.

Described from six specimens.

Chromoteleia, *Ashmead.*

Chromoteleia semicyanea, sp. n.

♂ ♀. Length 4·5 to 5 millim. Head and thorax cyaneous punctate. Abdomen sessile, very long, pointed fusiform, ochraceous, punctate, the first and second segments striate; first segment a little more than half the length of the second; second and third long, equal; the following segments shorter, subequal, the last two very minute. Legs yellow. Antennæ black, the scape yellow: in the female ending in a 6-jointed club; the first funicle-joint the longest, one half longer than the second and not quite twice the length of the pedicel, the third funicle-joint subequal with the second, the fourth a little longer than thick and stouter than the third: in the male subfiliform, the first flagellar joint twice the length of the pedicel, after the third the joints, except the last, about equal, less than twice as long as thick, the last long, ovate. Wings fuscous, the marginal vein punctiform, the basal nervure distinct; the stigmal slightly curved, ending in a small knob, with a slight trace of a radius.

Hab. St. Vincent.

Described from one male and one female, taken at an altitude of 2000 feet.

Opisthacantha, *Ashmead.*

Two species of this rare genus may be thus separated:—

Mesonotum without furrows.
  Polished black, impunctured, the petiole yellow; it,
    as well as the second abdominal segment, striate;
    postscutellar spine very minute.
   Legs and scape honey-yellow. ♀ .... *O. polita*, sp. n.

Mesonotum with two delicate furrows.
Brownish yellow, impunctured; metathorax and tip of abdomen obfuscated; petiole striate; the second abdominal segment smooth; postscutellar spine distinct.
Legs, scape, and pedicel yellow. ♂ ♀ .... *O. pallida*, sp. n.

OPISTHACANTHA POLITA, sp. n.

♀. Length 1 millim. Polished black; first and second abdominal segments striate; thorax without furrows; postscutellar spine minute; antennæ short, black, the scape and pedicel brown; first funicle-joint small, very little longer than thick, thinner than, and scarcely half the length of, the pedicel, the three following joints small, transverse; club large, stout. Wings subhyaline, the nervures brown; marginal vein somewhat thick, not quite as long as the slender stigmal vein; basal nervure subobsolete. Legs, including coxæ, brownish or honey-yellow. Abdomen oval, polished, the first and second segments striate, the third segment the largest, fully twice as long as the second, the first not longer than thick, shorter than the second.

Hab. St. Vincent.

Described from two specimens.

OPISTHACANTHA PALLIDA, sp. n.

♂. Length 1·2 millim. Pale brown; flagellum and metathorax fuscous; legs pale yellow. Head transverse, the lateral ocelli only their width from the margin of the eye; antennæ long, filiform; flagellar joints 1 and 2 scarcely twice as long as thick, the following joints to the last a little longer, the last joint one half longer than the penultimate. Thorax with two delicate but complete furrows. Postscutellar spur distinct, triangular. Wings fuscous, the basal nervure distinct, the marginal two thirds the length of the stigmal. Abdomen oblong-oval, depressed, the first three segments faintly aciculated, the first very little shorter than the second, more than twice as long as thick, the second and third about equal in length.

♀. Length 1·3 millim. The antennæ terminate in a large, dusky, 6-jointed club; the pedicel is longer than the first funicle-joint, the first and second funicle-joints subequal, scarcely longer than thick, the third quadrate, the fourth minute, transverse;

while the abdomen is longer and more pointed than in the male.

Hab. St. Vincent.

Described from one male and one female.

Lapitha, *Ashmead.*

Lapitha spinosa, sp. n.

♂. Length 3·5 millim. Head and thorax brownish yellow, finely and closely punctate; metathorax with oblique carinæ meeting at the base of the postscutellum; postscutellum produced into an acute spine. Legs yellow. Abdomen fusiform, extending slightly beyond the tip of the wings when folded, black, shining, closely punctate; sometimes the basal half of the third segment is yellow; first and second segments striate; the first segment is a little longer than wide, very slightly wider at apex than at base; the second and third are the longest segments, about equal in length; the fourth the length of the first; the fifth two thirds the length of the fourth; the sixth one half the length of fifth; the seventh very small, basally smooth; the eighth subtriangular, margined. Antennæ filiform, dark brown, the scape and pedicel yellow; second, third, and last joint of flagellum about equal in length; first and fourth joints about equal, shorter than the second; the joints beyond the third very slightly shorter. Wings hyaline, with a large discoidal blotch below the postmarginal vein; nervures fuscous; basal nervure distinct; marginal nervure as long as the shaft of the stigmal, the latter oblique, knobbed at the tip.

Hab. St. Vincent.

Described from four specimens taken at 1500 feet altitude.

Cacus, *Riley.*

Two species in the collection are distinguished as follows:—

Black, punctate; the apical half of abdomen in female rufous or piceous; petiole long, striate.
Wings hyaline; scape and legs honey-yellow. ♂ ♀ .... *C. insularis*, sp. n.

Brownish yellow or honey-yellow, the large 3rd abdominal segment black.
Wings hyaline, with a large smoky transverse discoidal blotch beyond the stigmal vein. ♂ .. *C. laticinctus*, sp. n.

CACUS INSULARIS, sp. n.

♂ ♀. Length 1·8 to 2·2 millim. Black, shining, sparsely punctate; head quadrate, the frons impressed; thorax without furrows, the metathorax with two teeth at base; legs, including coxæ, honey-yellow. Abdomen in female longer than the head and thorax together, depressed, rufous, the first two segments black, the first coarsely striate, the second finely aciculate, smooth at the sides, the following segments polished, impunctate; the second and third segments are about equal in length, the first slightly shorter, the fourth less than half the length of the third, the fifth shorter than the fourth, the sixth triangular, not longer than the fifth. In the male the abdomen is entirely black, with the second segment the longest, the petiole a little longer than the third. Antennæ in male filiform, reaching to the middle of the abdomen, in colour varying from pale brown to black, the scape always yellowish; the pedicel is very small; the first four flagellar joints are about equal, about 3½ times as long as thick, the following very slightly shorter. In the female the pedicel and first funicle-joints are lengthened, the latter one third longer than the former, the second funicle-joint half as long as the first, the third scarcely longer than thick, the fourth wider than long and thicker than the third. Wings hyaline, the marginal vein less than one half the length of the stigmal; no basal nervure.

Hab. St. Vincent.

Described from 12 male and 7 female specimens.

CACUS LATICINCTUS, sp. n.

♂. Length 1·8 to 2 millim. Honey-yellow, sparsely punctured; head quadrate; thorax without furrows, the metathorax with two erect teeth at base; hind coxæ, or at least basally, and the third abdominal segment black; eyes and ocelli brown-black; flagellum brown; legs yellowish white. Wings hyaline, with a large fuscous blotch across the apical disk beyond the stigmal vein; basal nervure distinct; marginal nervure scarcely half the length of the stigmal.

Hab. St. Vincent.

Described from 23 male specimens.

ANTERIS, *Förster*.

ANTERIS RUFIPES, sp. n.

♂ ♀. Length 1·8 millim. Black, closely, microscopically punctate; mandibles and legs rufous; head transverse. Antennæ

12-jointed; in female ending in a 6-jointed club, first funicle-joint about as large as the pedicel, 2nd, 3rd, and 4th joints moniliform, the 4th the smallest, transverse: in male filiform moniliform, the second flagellar joint and the pedicel about equal, the first flagellar joint twice as long as the pedicel, the fourth dilated, the following moniliform, loosely joined, becoming very slightly smaller toward apex, the last cone-shaped. Thorax with two delicate furrows, less distinct anteriorly in the female. Wings hyaline, the nervures dark brown, the basal nervure wanting or subobsolete; marginal nervure a little shorter than the shaft of the stigmal. Abdomen long ovate or subfusiform, a little longer than the head and thorax together, finely punctate, the first and second segments striate; the third segment is the longest; the first segment, in the female, has a triangular prominence or ridge at its base. Anterior tibiæ very short, swollen.

Hab. St. Vincent.

Described from two male and two female specimens.

CREMASTOBÆUS, *Ashmead*.

The two species may be thus distinguished:—

Wholly black, the legs yellow .... *C. niger*, sp. n.
Head and thorax black; abdomen rufous .... *C. bicolor*, sp. n.

CREMASTOBÆUS NIGER, sp. n.

♂ ♀. Length 1 millim. Black, subopaque, minutely punctate, pubescent, the thorax more lustrous than the head; antennæ brownish yellow, paler at base; legs yellow. Head subquadrate, rounded anteriorly, the lateral ocelli touching the border of the eye; the eyes pubescent. Thorax with two delicate furrows. Wings hyaline, the stigmal vein oblique, slightly shorter than the marginal vein. Abdomen long ovate, in female longer than the head and thorax together, in male slightly shorter, less pointed behind, the sutures between the segments deeply impressed, crenate or striate at bottom, the first segment longitudinally striate. The antennæ in the male are subfiliform moniliform, very slightly thickened toward tips, rust-brown; in female paler and ending in a 5-jointed club.

Hab. St. Vincent.

Described from one female and two male specimens.

CREMASTOBÆUS BICOLOR, sp. n.

♀. Length 1·1 millim. Head and thorax black, faintly

microscopically punctate, scarcely sufficient to destroy the lustre of the surface; eyes oval, pubescent; abdomen rufous, subfusiform, longer than the head and thorax together, the segments strongly constricted at the sutures, the sutures crenate; legs yellowish. Antennæ 12-jointed, brownish yellow, the club oval-rotund, 5-jointed, black; the first funicle-joint is the thickest and largest joint, the following, to the club, gradually subequal, the last two rounded, a little transverse. Wings hyaline, the marginal vein a little longer than the stigmal, the latter oblique, ending in a little knob; no basal nervure.]

Hab. St. Vincent.

Described from one female specimen.

HADRONOTUS, *Förster.*

So far as we know this genus is parasitic only on Hemipterous eggs. Several species are in the collection, and may be recognized by the aid of the following table:—

Species either smooth, or minutely or microscopically punctate .... 2.

Species coarsely rugoso-punctate.

Head with two facets on vertex, behind the front ocellus; frons separated from the face by a transverse carina, the face transversely striate; thorax with irregular longitudinal carinæ.

Scape and legs honey-yellow .... *H. carinatifrons,* sp. n.

Head evenly rugoso-punctate, the frons not separated from the face by a carina; no facets on vertex.

Antennæ and legs black; second joint of trochanters, extreme tips of femora, and tibiæ and tarsi honey-yellow .... *H. insularis,* sp. n.

2. Black, polished, but with a microscopic punctation.

Scape and mandibles brownish yellow; legs reddish or honey-yellow; first and second abdominal segments faintly longitudinally aciculated .... *H. politus,* sp. n.

Black, minutely, closely punctulate, opaque.

Head scarcely twice as wide as thick antero-posteriorly, the face above the antennæ deeply impressed.

Abdomen pale rufous; legs and scape yellow. *H. bicolor,* sp. n.

HADRONOTUS CARINATIFRONS, sp. n.

♀. Length 1·5 millim. Robust, black, shining, very coarsely rugose; scape and legs honey-yellow. Head very large and broad, coarsely rugose, with two facets on vertex between the ocelli; face transversely striate, separated from the frons by a transverse carina. Funicle-joint 1 and the pedicel long, about equal in length; joint 2 shorter, 3 and 4 wider than long. Thorax with irregular longitudinal raised lines posteriorly. Wings hyaline, the venation pale yellowish, the marginal vein almost as long as the stigmal. Abdomen broadly oval, sessile, evenly rugoso-punctate, the first segment and the second at base striate, the second fully twice as long as the first.

Hab. St. Vincent.

Described from a single specimen.

HADRONOTUS INSULARIS, sp. n.

♂ ♀. Length 1·8 to 2 millim. Robust, subopaque, coarsely but evenly rugose; eyes pubescent; second joint of trochanters, apex of femora, the tibiæ and tarsi, honey-yellow. Abdomen rugose, the first and second segments with the rugosities longitudinally directed; the extreme apices of the segments smooth, polished; second segment not twice as long as the first. Wings subhyaline, the marginal vein punctiform.

In the female the first funicle-joint is hardly as long as the pedicel, the second, third, and fourth joints transverse: in the male the antennæ are filiform, tapering towards apex, the first flagellar joint much longer than the pedicel, the second much shorter, the third slightly dilated and laterally, at base, excised, the following joints quadrate, loosely joined, the penultimate a little longer than wide, the last still longer, conical.

Hab. St. Vincent.

Described from three male and three female specimens.

HADRONOTUS POLITUS, sp. n.

♀. Length 0·8 millim. Black, polished, but still faintly microscopically punctate; scape, mandibles, and legs reddish or honey-yellow. Head transverse, the eyes bare. First funicle-joint very little longer than thick, much smaller than the pedicel, the three following subequal, moniliform. Thorax rounded, the mesonotum twice as wide as long, rounded anteriorly. Wings hyaline, the venation pale yellow, the marginal vein short.

Abdomen broadly oval, the first and second segments equal, faintly aciculated.

Hab. St. Vincent.

Hadronotus bicolor, sp. n.

♀. Length 0·6 millim. Brown-black, minutely, closely punctate; face deeply emarginated for the antennæ; scape, mandibles, legs, and abdomen rufous; pedicel two thirds the length of the funicle; first funicle-joint not longer than thick, the second, third, and fourth minute, transverse. Wings hyaline, the marginal vein very short, about twice as long as thick. Abdomen oval, punctate, the first and third segments about equal, shorter than the second, the first striate.

Hab. St. Vincent.

Described from two specimens.

Idris, *Förster*.

Idris ænea, sp. n.

♂ ♀. Length 2 to 2·1 millim. Black, the head and thorax with a decided æneous tinge; head sparsely punctate and striate, a smooth impunctured space above the antennæ; eyes hairy. Antennæ brown, the scape long, reddish yellow; first funicle-joint very little shorter than the pedicel; second two thirds the length of the first; third and fourth minute. Thorax ovate, subdepressed, punctate, with a smooth, impunctate space at the middle; the mesonotum a little wider than long, arcuate anteriorly, with two distinct furrows. Wings fuscous, the venation brown-black, the marginal vein punctiform, the postmarginal but slightly developed, shorter than the stigmal, the latter short, oblique, ending in a rounded knob. Legs honey-yellow. Abdomen oblong oval or ovate, very little longer than the head and thorax together, striate, the fourth and following segments punctate; the first segment is scarcely as long as the second and has a prominence or carina at base, its tip ending in a small thorn or spur; the third segment is the longest, about one half longer than the second.

The male differs from the female in the filiform, brown-black antennæ, the scape being yellow; the first funicle-joint is the longest, much longer than the pedicel, about twice as long as thick, the following joints except the last about equal, very little longer than thick.

Hab. St. Vincent.

Described from two females and one male.

Subfamily PLATYGASTERINÆ.

INOSTEMMA, *Haliday*.

Two species of this genus have been recognized, distinguished as follows:—

Orbits produced into a spine-like tubercle above the eye .... *I. bicornutus*, sp. n.

Orbits normal.

Legs and antennæ black; trochanters, base of tibiæ and tarsi yellowish .... *I. simillimus*, sp. n.

INOSTEMMA BICORNUTUS, sp. n.

♀. Length 1 millim. Black, shining; the head and thorax microscopically punctate, the orbits produced into an acute tubercle above the eye; tibiæ piceous; tarsi and apex of pedicel yellowish. Antennæ 10-jointed, the pedicel longer than the first funicle-joint; funicle-joints 1 and 2 about equal, a little longer than thick; 3 and 4 minute, narrowed; club 4-jointed, the first three joints broader than long, the first the narrowest, the third the broadest, last joint conical. Wings hyaline. Abdomen pointed, longer than the head and thorax together, the horn at base extending forward over the thorax to the vertex of head, the first segment and the second at base faintly striate.

Hab. St. Vincent.

Described from two female specimens. The acute tubercles above the eyes readily distinguish the species.

INOSTEMMA SIMILLIMUS, sp. n.

♂ ♀. Length 0·8 millim. Black, shining; the head and thorax microscopically punctate; no tubercles over the eye; trochanters and tibiæ pale brown or yellowish, base of tibiæ and tarsi yellowish. Antennæ 10-jointed; funicle-joints 1 and 2 slightly subequal, shorter than the pedicel; 3 and 4 small, the 3rd not wider than long, the 4th twice as wide as long. Wings subhyaline, hyaline at base. Abdomen not longer than the head and thorax together, the horn extending to the base of the head.

In the male the thorax above is polished, impunctured, with delicate but complete parapsidal furrows; scape beneath,

trochanters, the tibiæ, except at tips, and the tarsi honey-yellow; the flagellum is covered with a whitish pile; the first and second joints are twice as long as thick, about equal, a little longer than the pedicel; third joint short, triangular; club 5-jointed, the joints oval, the last conical, longer than the penultimate.

Hab. St. Vincent.

Described from one male and one female. This species comes quite close to *I. Lintnerii*, Ashm., described from the District of Columbia.

ACEROTA, *Förster*.

ACEROTA CONFUSA, sp. n.

♂ ♀. Length 1 to 1·1 millim. Subrobust, polished black; the head closely, microscopically punctate; antennæ and legs yellowish; scape at the middle, club, and the swollen part of the tibiæ fuscous or brown, the coxæ black; the pedicel is longer than the first funicle-joint; the second funicle-joint slightly longer than half the length of the first; the third and fourth transverse; club joints subquadrate. The thorax is polished, but faintly punctate and with two distinct furrows. Scutellum convex, finely punctate, and bounded by a carina behind. Metapleura subsericeous. Wings hyaline. Abdomen oblong-oval; in female subacute at tip, polished, with the first segment striate.

The antennæ in the male are wholly black, covered with a short white pile; the second funicle-joint is subequal with the first, the third very small; the club 5-jointed, the joints, except the long conical last joint, not longer than wide, slightly pedicellated; while the abdomen is bluntly rounded at tip.

Hab. St. Vincent.

Described from one male and one female. The male of this species could easily be mistaken for a male *Inostemma*.

AMBLYASPIS, *Förster*.

The species I take to belong to this genus may be tabulated as follows:—

Scutellum triangular, pubescent .... *A. triangularis*, sp. n.
Scutellum produced into a long spine that projects
  high over the metathorax.
  Coxæ pale .... 2.

Coxæ black.

Legs and antennæ black; trochanters and tarsi brownish yellow .... *A. nigricornis*, sp. n.

2. Legs and antennæ, except the club, brownish yellow or honey-yellow.

♂ with the claval joints several times longer than thick, clavate, with whorls of very long white hairs.

♀ with claval joints a little less than twice as long as thick. (Species large.).......... *A. verticillatus*, sp. n.

♂ with claval joints not more than thrice as long as thick, cylindrical, pilose.

♀ with claval joints not or scarcely longer than wide. (Species small.) .... *A. xanthopus*, sp. n.

AMBLYASPIS TRIANGULARIS, sp. n.

♂ ♀. Length 0·65 to 0·85 millim. Polished black, impunctured; head transverse, the vertex subacute, the lateral ocelli as near to the middle ocellus as to the margin of the eye. Antennæ in female brown-black, the scape at base and beneath paler; pedicel much longer than the first funicle-joint; second funicle-joint very slightly shorter than first, only a little longer than thick; third smaller; fourth wider than long; club 4-jointed, the joints, except the last, wider than long, the third the widest. Thorax convex, without a trace of the furrows; the scutellum triangular, subconvex, covered with a rather dense fuscous pubescence. Wings hyaline. Legs reddish yellow or brownish yellow, the swollen parts of the posterior femora and tibiæ brownish or obfuscated. Abdomen ovate; the petiole rugose, with a greyish pubescence.

In the male the scape and pedicel are yellow, the flagellum brown; the pedicel is as long as the first and second funicle-joints together; first funicle-joint shorter and slenderer than the second; third equal, or very slightly longer than the first; club 5-jointed, the joints loosely joined, the first moniliform, the three following elliptic-oval; legs, including the coxæ, reddish yellow or honey-yellow; the tarsi longer than their tibiæ; the hind tibial spurs distinct; abdomen oblong-oval, pubescent at base.

Hab. St. Vincent.

Described from one female and ten male specimens.

AMBLYASPIS NIGRICORNIS, sp. n.

♀. Length 2 millim. Polished black, impunctured; head

transverse, the vertex with a delicate transverse carina behind the ocelli; the lateral ocelli not more than twice their width from the margin of the eye. Antennæ black; the funicle slender, the first joint longer than the pedicel; club slender, the joints all longer than thick. Thorax convex, without furrows. Scutellum depressed at base, and produced into a long acute yellow spine. Mesopleura, except just beneath the tegulæ, which is striate, smooth, shining. Metapleura bare and smooth, bounded by a carina above; the lower half of the carina with a fringe of pale pubescence. Metathorax with a prominent yellow median carina. Wings hyaline. Legs black; the trochanters and base of tibiæ pale brown; tarsi yellowish. Body of abdomen oval, smooth, impunctured, with a tuft of pubescence at base beneath; petiole longer than thick, impressed at the middle, fluted, subpubescent at apex and beneath.

Hab. St. Vincent.

Described from a single specimen.

AMBLYASPIS VERTICILLATUS, sp. n.

♂ ♀. Length 1·5 millim. Polished black, impunctured; the mesopleura with no striæ beneath the tegulæ; scutellum produced into a long, acute, yellow spine. Antennæ and legs honey-yellow; club piceous, the joints very long, subclavate, as long as the basal joint of tarsi, and with whorls of long hairs; funicle long, slender, cylindrical, the second joint more than twice as long as the pedicel, the first joint short. Wings hyaline. Body of abdomen oval; the petiole about twice as long as thick, depressed at the middle, fluted, subpubescent.

The female agrees well with the male, except that the antennæ end in a 4-jointed black club, the joints of which are only slightly longer than thick; the funicle is long, slender, and cylindrical, the first and second joints being about equal and as long as the pedicel; the extreme apex of posterior femora and tibiæ obfuscated or brown; while the lateral ocelli are only their width from the margin of the eye.

Hab. St. Vincent.

Described from one male and one female.

No male is described in this genus with similar antennæ, and no difficulty will attend its recognition. It is doubtful whether the female correlated here is the opposite sex of this species.

AMBLYASPIS XANTHOPUS, sp. n.

♀. Length 0·8 millim. Polished black, impunctured; petiole more or less yellowish. Lateral ocelli close to the margin of the eye. Thorax convex; the parapsidal furrows very slightly indicated posteriorly; scutellum produced into a long, acute, yellow spine. Antennæ and legs bright yellow; the club brown or black; the joints, except the last, less than twice as long as thick, slightly pedicellate, with long hairs; funicle slender, the first and second joints about equal in length, shorter than the pedicel. Wings hyaline, with long cilia. Body of abdomen rotund; the petiole longer than thick, pubescent.

Hab. St. Vincent.

Described from four specimens. Comes nearest to *A. minutus*, Ashm., described from the United States.

LEPTACIS, *Förster*.

(? Ceratacis, *Thoms.*)

The two species recognized in this genus may be separated as follows:—

Mesonotal furrows delicate but complete.
  Legs rufo-piceous; trochanters, base of tibiæ (the anterior pair entirely), and tarsi yellowish .... *L. obscuripes*, sp. n.
Mesonotal furrows entirely wanting.
  Legs entirely reddish yellow .... *L. erythropus*, sp. n.

LEPTACIS OBSCURIPES, sp. n.

♂. Length 0·6 millim. Black, shining; the head transverse, microscopically punctate, subopaque, the lateral ocelli being close to the border of the eye. Antennæ brownish yellow; the club brown-black, the joints oval; pedicel long and slender, nearly as long as the first and second funicle-joints united; the first funicle-joint small but longer than thick, the second thicker and about twice as long, the third small. Thorax with two distinct furrows; scutellum subconvex, foveated at base, and ending in a long awl-shaped spine; metapleura wrinkled, subpubescent, bounded by a keel above. Legs rufo-piceous; the trochanters, base of tibia, except the anterior pair which are entirely yellow, and the tarsi yellowish. Wings hyaline, the margins not fringed. Abdomen oval; the petiole wider than long, subpubescent.

Hab. St. Vincent.

Described from a single specimen.

LEPTACIS ERYTHROPUS, sp. n.

♂. Length 0·8 millim. Black, shining; the head transverse, subopaque; the lateral ocelli close to the eye. Antennæ reddish or brownish yellow; the club brown-black, 5-jointed, pubescent, the joints longer than thick; pedicel longer than the second funicle-joint; first funicle-joint short, smaller than the third. Thorax convex, without furrows. Scutellum subconvex, bifoveated at base, and terminating in a long awl-shaped spine; a deep groove between the tegulæ and the mesonotum; metapleura covered with a silvery pubescence. Wings hyaline, fringed. Legs reddish yellow or rufous. Abdomen ovate, pubescent at base; the first segment much wider than long.

Hab. St. Vincent.

Described from two specimens.

POLYMECUS, *Förster*.

Only one species of this common genus is in the collection, which may be described as

POLYMECUS INSULARIS, sp. n.

♀. Length 1·4 millim. Polished black; the frons and face finely opaquely punctate; antennæ and legs brownish yellow; the club 4-jointed, black. Mesothorax twice as long as wide, with two furrows; scutellum ending in an awl-shaped spine, pubescent at sides and foveate at base; metapleura woolly. Wings hyaline. Abdomen longer than the head and thorax together, narrowly contracted from the apex of the second segment, smooth, shining; the first segment densely woolly; the penultimate segment longer than either the antepenultimate or the ultimate; last three segments *beneath* finely opaquely punctate.

Hab. St. Vincent.

Described from a single specimen.

SACTOGASTER, *Förster*.

Six species of this genus are recorded from Europe and two from the United States. The two species described below are apparently quite distinct, although one is closely allied to a species from North America. The colour of the legs will aid in identification, as follows :—

Legs black or piceous, the trochanters, base of tibiæ, and tarsi honey-yellow or brownish yellow
 Antennæ black or brown-black .... *S. affinis*, sp. n.
Legs reddish yellow.
 Antennæ, except the club, brownish yellow .... *S. rufipes*, sp. n.

SACTOGASTER AFFINIS, sp. n.

♀. Length 0·8 millim. Polished black; frons and face microscopically punctate, the vertex and occiput smooth, impunctured; the lateral ocelli their width from the margin of the eye. Antennæ black or brown-black; the extreme base of the scape pale or yellowish; first and second funicle-joints subequal, the last rounded; club 4-jointed, the basal three joints wider than long. Scutellum at sides subpubescent, at tip ending in an awl-shaped spine. Metathorax and base of scutellum with a silvery-white pubescence. Wings hyaline. Legs black or piceous; the trochanters, base of tibiæ, and the tarsi honey-yellow. Abdomen polished; the tail not longer than the inflated second ventral segment; the last segment pointed, about one half longer than the penultimate segment.

Hab. St. Vincent.

Described from five specimens. Closely allied to *S. anomaliventris*, Ashm., but slightly smaller, with the vertex, occiput, and mesonotum smoother, more shining, while the space between the eyes is a little narrower.

SACTOGASTER RUFIPES, sp. n.

♀. Length 0·8 millim. Differs from *S. affinis* in having the scape and legs rufous or reddish yellow; the coxæ rufo-piceous, not entirely black; the occiput subopaque; the scutellum more densely covered with a silvery pile. In the male the head is narrower, the lateral ocelli touching the border of the eye, the scutellum and metapleura bare, legs more yellowish, while the club-joints are loosely joined, twice as long as thick.

Hab. St. Vincent.

Described from two male and two female specimens.

COELOPELTA, *Ashmead.*

Antennæ in male 9-jointed, ending in a 4-jointed club; lateral ocelli as near to the front ocellus as to the margin of the eye. Scutellum cupuliform, similar to the Cynipid genus *Eucoila*. Female unknown.

These simple characters readily distinguish this genus from all other genera in the group; and the genus affords another proof of the close affinities between the Proctotrypidæ and the Cynipidæ.

Cœlopelta mirabilis, sp. n.

♂. Length 0·8 millim. Polished black; antennæ brown, the scape yellow; legs reddish yellow, the coxæ black; metathorax with a silvery pubescence. Wings hyaline, iridescent; the hind wings rounded at apex, with long cilia; abdomen ovate, polished; the petiole subopaque, striate, and bare.

Hab. St. Vincent.

Described from a single specimen.

Synopeas, *Förster.*

A single male specimen, doubtfully referred to this genus, may be called

Synopeas dubius, sp. n.

♂. Length 1 millim. Polished black, impunctured; head transverse, wider than the thorax; the occiput faintly transversely aciculated; the frons and face highly polished; lateral ocelli about their width from the margin of the eye. Antennæ brown-black; the scape and pedicel brownish yellow; first funicle-joint rounded, the second a little stouter and nearly twice as long as thick; club 6-jointed, the joints loosely joined, elliptic-oval, the last fusiform, nearly twice as long as the preceding. Thorax convex, with faint traces of the parapsidal furrows in front of the scutellum, the base of the middle lobe thus formed projecting slightly upon the scutellum; scutellum convex, with oblique foveæ on either side at base, the small tubercle at its tip very pubescent; metathorax subpubescent. Legs honey-yellow, the posterior tibiæ slightly dusky. Abdomen ovate, longer than the thorax; the petiole longer than thick, striate, subpubescent; rest of the abdomen smooth, shining; the second segment with two sulci at base.

Hab. St. Vincent.

Described from a single specimen.

Anopedias, *Förster.*

Anopedias conica, sp. n.

♂ ♀. Length 0·7 to 0·8 millim. Polished black, impunctured; lateral ocelli about twice their width from the margin of the eye,

a little closer in the male; mesonotum with two delicate but distinct furrows; metapleura bare or subpubescent; first and second funicle-joints about equal, a little longer than thick, shorter than the pedicel, the third elongate, the fourth short; club cylindrical, the joints about twice as long as thick, or very little longer. Wings hyaline, fringed. Legs black; trochanters, base of tibiæ, and the tarsi variable from a piceous to yellow. Abdomen conic-ovate, longer than the head and thorax together, petiolate; the petiole striate; rest of the abdomen smooth, polished; the second segment with two long sulci at base, one on each side.

Hab. St. Vincent.

Described from one male and ten female specimens. Comes very close to *A. error*, Fitch, but is smaller, with the joints of the antennæ relatively different.

TRICHACIS, *Förster*.

TRICHACIS RUBICOLA, *Ashm., Monog. N.A. Proctotrypidæ*, p. 296.

Of this species there are two specimens agreeing in every particular with the types in the U.S. National Museum. It was reared from a Cecidomyid gall on Blackberry.

POLYGNOTUS, *Förster*.

Of this genus, as now limited, five species have been recognized, which may be distinguished by the following table:—

Males..................................	2.
Females.	
Mesonotal furrows distinct posteriorly for half the length of the mesonotum.	
Head much wider than thorax, the lateral ocelli twice their width from the eye-margin.	
Legs black or piceous black, the trochanters, base of tibiæ, and tarsi pale brown; antennæ brown-black, the scape pale at extreme base.....................	*P. meridionalis*, sp. n.
Mesonotal furrows wanting or but slightly indicated posteriorly.	
Head not so wide, the lateral ocelli not much more than their width from the eye-margin.	
Legs brownish yellow, the coxæ black, the femora more or less piceous; antennæ brown, the scape brownish yellow	*P. insularis*, sp. n.

2. Mesonotal furrows indicated posteriorly.
   Head wider than the thorax, the lateral ocelli twice their width from the eye-margin.
      Legs piceous; the trochanters, base of tibiæ, and tarsi yellowish .... *P. meridionalis*, sp. n.
   Lateral ocelli not twice their width from the eye-border.
      Coxæ black.
         Legs black; trochanters, base of tibiæ, and tarsi piceous or brown.
            Antennæ black, the club-joints $1\frac{1}{2}$ times as long as thick .... *P. gracilicornis*, sp. n.
         Legs honey-yellow.
            Antennæ brown-black, the scape yellowish, the club-joints twice as long as thick .... *P. insularis*, sp. n.
         Legs piceous; trochanters, base and tip of tibiæ, and the tarsi yellowish.
            Antennæ brown-black, short, the club-joints wider than long.......... *P. laticlavus*, sp. n.
      Coxæ pale.
         Scape and legs reddish- or honey-yellow; club 6-jointed, the joints, except the last, moniliform .... *P. pallidicoxalis*, sp. n.

POLYGNOTUS MERIDIONALIS, sp. n.

♂ ♀. Length 0·9 to 1 millim. Polished black, impunctured; lateral ocelli twice their width from the eye-border; antennæ brown-black, the scape at extreme base and the minute first funicle-joint yellowish; the flagellum with sparse white hairs; second funicle-joint as large as the pedicel, a little swollen, third small; club 5-jointed, the joints loosely joined, very little longer than wide. Thorax with two delicate furrows on the posterior half of the mesonotum; scutellum highly convex, subpubescent; metathorax pubescent. Wings hyaline, with a short fringe at apex. Legs black or piceous; the trochanters, base of tibiæ, and the tarsi pale brown or yellowish. Abdomen oblong-oval, the petiole striate, pubescent beneath.

The female is the larger, more robust form, with the head much broader than in the male, the club-joints scarcely longer than wide, the scutellum higher, the abdomen ovate, while the legs are blacker.

Hab. St. Vincent.

Described from one male and one female.

POLYGNOTUS INSULARIS, sp. n.

♂ ♀. Length 1 to 1·1 millim. Polished black, impunctured; lateral ocelli not twice their width from the eye-border; antennæ dark brown, the scape brownish yellow, the club-joints a little wider than long. Thorax without furrows or but slightly indicated posteriorly, with two opaque pubescent spots just in front of the scutellum. Scutellum high, convex, polished. Metapleura finely striate, subpubescent. Wings hyaline, with a short fringe. Legs brownish yellow or yellowish, the coxæ black, the femora in female a little piceous. Abdomen oblong-oval, about as long as the head and thorax together, with the first segment striate.

The male is the smaller, and differs in having all the legs honey-yellow, with the antennal club 5-jointed, the joints nearly or quite twice as long as thick, the last conical, three times as long as thick.

Hab. St. Vincent.

Described from one male and one female.

POLYGNOTUS GRACILICORNIS, sp. n.

♂. Length 1 millim. Polished black, impunctured; lateral ocelli only about their width from the eye-border; antennæ black; the first funicle-joint very small and slender, but still longer than thick; the second somewhat swollen and twisted, about twice as long as thick, the third smaller; club slender, the joints, except the last, once and a half as long as wide, the last conical, twice as long as the penultimate. Thorax with delicate furrows posteriorly. Scutellum convex, polished, faintly pubescent. Legs black, anterior tibiæ and all tarsi yellowish, trochanters and base of middle and posterior tibiæ piceous or yellowish. Abdomen oblong, as long as the thorax, polished, with the first segment striate, the second at base with two striate foveolæ.

Hab. St. Vincent.

Described from a single specimen.

POLYGNOTUS LATICLAVUS, sp. n.

♂. Length 0·65 millim. Differs principally in the joints of the antennæ: the first and second funicle-joints are closely united, the second being much the larger; the first club-joint is oval, the three following broadly transverse, the last oblong; the legs are piceous, the trochanters, tips of anterior tibiæ, the base of middle

and hind tibiæ, and all tarsi yellow; while the abdomen is oval, shorter than the thorax.

Hab. St. Vincent.

Described from a single specimen.

POLYGNOTUS PALLIDICOXALIS, sp. n.

♂. Length 0·9 millim. In this species the legs are pale brownish or honey-yellow, the hind coxæ alone at base being slightly dusky; antennæ brown, the scape yellow; the first funicle-joint is minute, transverse, the second as large as the pedicel, the third a little smaller; the club-joints, except the last, moniliform, very little, if any, longer than thick; the last conic ovate, about twice as long as the preceding joint; all the club-joints are briefly pedicellate and covered with sparse white hairs.

Hab. St. Vincent.

Described from a single specimen.

Subfamily DIAPRIINÆ.

Tribe i. SPILOMICRINI.

IDIOTYPA, *Förster.*

IDIOTYPA PALLIDA, sp. n.

♂ ♀. Length 1·8 to 2 millim. Reddish-testaceous, smooth, shining; eyes and antennal club black or brown-black; legs yellow-testaceous. Antennæ in female 12-jointed, the club robust, 4-jointed, black; funicle-joints gradually widened toward the club, the first joint a little longer and thinner than the pedicel; club-joints large except the last, transverse-moniliform, the last large, conic: in male 13-jointed, long, filiform, the pedicel rounded, the flagellar joints about thrice as long as thick, loosely joined, the first and last a little longer than the others. Thorax with two furrows; scutellum trifoveated at base, the lateral foveæ being towards one side of the apex of the middle fovea; metathorax rugose, pubescent, the posterior angles subacute, the central carina produced into a blunt spine. Wings hyaline, pubescent, ciliated, the marginal and basal veins distinct, the marginal thrice as long as thick; the stigmal vein short, with a backward directed branch from its tip. Abdomen oval, the petiole in the male about twice as long as thick, a little shorter

and stouter in the female, striate; rest of abdomen smooth, polished, the second segment at base sulcate, with some striæ at extreme base.

Hab. St. Vincent.

Described from one male and two female specimens.

HEMILEXIS, *Förster*.

HEMILEXIS LATIPENNIS, sp. n.

♂. Length 1 millim. Brownish, smooth, impunctured, the metathorax and legs yellowish; head black above. Antennæ 13-jointed, pale brownish, the scape yellowish; first and second flagellar joints elongate, the second two thirds the length of the first; joints beyond to the last elliptic-oval, slightly pedicellate, pubescent, the last conic. Thorax with two delicate furrows; scutellum with a single large fovea at base; metathorax punctate, with a median carina, and with the posterior angles produced into small acute teeth. Wings very broad, hyaline, pubescent, with long cilia, the apical margin very slightly emarginate or sinuate, the marginal vein punctiform, the stigmal vein a little more than thrice as long as thick. Abdomen oval, petiolated, the petiole about thrice as long as thick, faintly striate; body smooth, polished, the second segment with a small median sulcus at base.

Hab. St. Vincent.

Described from a single specimen.

HEMILEXODES, *Ashmead*.

HEMILEXODES FILIFORMIS, sp. n.

♂. Length 0·9 millim. Polished black; scape, metathorax, petiole, and legs honey-yellow. Thorax without furrows; scutellum with a fovea at base; metathorax rugoso-punctate, the posterior angles acute. Antennæ 13-jointed, long, filiform, pilose; the joints of the flagellum all long, cylindrical, the second a little shorter than the first, very slightly dilated towards tip. Wings hyaline, with long cilia, the apical margin very slightly sinuate; the venation as in *Hemilexis*, the marginal vein being punctiform and the stigmal about four times as long as thick.

Hab. St. Vincent.

Described from a single male specimen.

TROPIDOPSIS, *Ashmead.*

TROPIDOPSIS CLAVATA, sp. n.

♂ ♀. Length 1·3 to 1·5 millim. Brownish red or ferruginous, smooth, polished, impunctured; antennæ, except the club, and legs paler, more yellowish. Antennæ in female 12-jointed, ending in an abrupt 3-jointed black club, the first two joints of which are quadrate, the last oblong; funicle 7-jointed, slender, the first joint about twice as long as the second, the following joints not longer than thick, the last two or three slightly transverse; pedicel obconic, much longer and stouter than the first funicle-joint. Head globose, the face flat, with a very delicate carina at the sides; eyes large, rounded. Scutellum with a single fovea at base. Metathorax with a central carina, emarginate behind, the angles a little prominent. Abdomen oblong-oval, the petiole a little longer than thick, pubescent. Wings hyaline, fringed, the submarginal vein reaching the costa at about the middle of the wing and ending in a subtriangular marginal vein; basal nervure present, straight.

The male is slightly smaller, the head more transverse, without the delicate carinæ at the sides of the face; the antennæ longer than the body, 14-jointed, filiform; the flagellar joints, except the last, elliptic-oval, pubescent, the first three joints being a little more slender than the following; metathorax emarginate behind, pubescent, with a prominent central carina; while the abdominal petiole is almost twice as long as thick, cylindrical, striate, and pubescent.

Hab. St. Vincent.

Described from one male and one female.

PARAMESIUS, *Westwood.*

PARAMESIUS THORACICUS, sp. n.

♂ ♀. Length 1·5 to 1·8 millim. Head and body of abdomen polished black; thorax variable, from a dark honey-yellow to brown or piceous; the male the paler, the female the darker, with the pleura and metathorax sometimes black; scape, petiole, and legs reddish yellow or honey-yellow. Antennæ in female 13-jointed, clavate, the scape very long; the flagellum gradually becomes brown-black at tip, the joints gradually increasing in size after the sixth, submoniliform, the last large, conic, nearly thrice as long as the penultimate; in the male filiform, 13-

jointed; the flagellar joints, after the first, all elongate, cylindrical, the first very small, smaller than the pedicel, the second thrice as long as the pedicel, excised at base. Thorax smooth, shining, with two furrows; scutellum with a large fovea at base; metathorax rugose, with a sharp median carina. Wings hyaline, pubescent, ciliate; the venation brown, the marginal vein thrice as long as thick, a little narrower at base than at tip; stigmal vein scarcely developed, not longer than thick; basal vein subobsolete or entirely absent. Abdomen in female conic-ovate, the petiole about twice as long as thick, striate; in male pear-shaped, the petiole about four times as long as thick; body of abdomen in both sexes highly polished.

Hab. St. Vincent.

Described from four male and four female specimens.

SPILOMICRUS, *Westwood*.

The following table will assist in recognizing the species in this genus.

Wings subfuscous, the basal vein absent.
 Legs dark rufous, the coxæ black or piceous.
  Antennæ brown-black, the second flagellar joint shorter than the first, excised at base ...... *S. aneurus*, sp. n.
Wings hyaline, the basal vein present.
 Legs, including coxæ, reddish yellow.
  Antennæ pale brown, the scape and pedicel yellowish, second flagellar joint not excised at base .... *S. vulgaris*, sp. n.

SPILOMICRUS ANEURUS, sp. n.

♀. Length 3·2 millim. Polished black, impunctured; head globose, the cheeks woolly behind; frontal prominence large, the face with a Λ-shaped sulcus; mandibles black or piceous. Antennæ 13-jointed, black, much thickened towards tips; scape about as long as the first four funicle-joints combined, curved; first funicle-joint longer than the pedicel, the latter equal with the second funicle-joint; joints from the fifth to the penultimate quadrate moniliform, the last conic, not longer than, and scarcely as wide as, the penultimate. Thorax with two furrows; the pronotum woolly at sides, and produced anteriorly above into a short neck; scutellum with a subapical transverse furrow, sulcate at sides, and with two large foveæ at base; postscutellum closely punctate, tricarinate; metathorax rugose, pubescent, with an

acute median carina, rather prominent angles posteriorly, and with lateral carinæ. Legs dark rufous, pubescent, the coxæ piceous or black. Wings subfuscous, pubescent, the submarginal vein reaching the costa at half the length of the wing, the marginal vein about three times as long as thick, the stigmal vein very short, not longer than thick. Abdomen oblong-oval, polished, pilose at apex; the petiole long, three times as long as thick, fluted, woolly beneath.

♂. Length 3·5 to 4 millim. Agrees well with the female except that the scutellum has a transverse row of coarse punctures at the apex, the last ventral segment is bifoveate, with a central carina, while the antennæ are long, filiform; the scape is finely striated beneath, and about as long as the pedicel and first flagellar joint united, second funicle-joint about two thirds the length of the first, excised at base; the joints beyond the last very nearly equal in length.

Hab. St. Vincent.

Described from one female and five male specimens.

SPILOMICRUS VULGARIS, sp. n.

♀. Length 1·5 to 2·5 millim. Polished black, impunctured; head globose, sparsely pilose, the cheeks with a tuft of wool behind; face smooth, not sulcate; mandibles yellowish. Antennæ 13-jointed, brownish yellow, with only three or four terminal joints dusky or black; scape about as long as the first five funicle-joints united; first funicle-joint not or very little longer than the pedicel, the latter much the stouter; funicle-joints 2 to 4 subequal, shorter than the first; joints 5 and 6 moniliform; club 5-jointed, the joints transverse or subquadrate moniliform, the first pale, the last three or four black. Thorax with two furrows, the pronotum woolly at sides anteriorly; scutellum with two large foveæ at base, a sulcus at the sides, and a transverse punctate line at apex; metathorax rugose, pubescent, with an acute ridge at the middle and carinæ laterally. Legs entirely reddish or brownish yellow. Wings hyaline, the basal nervure distinct, rarely subobsolete. Abdomen oblong-oval, polished, pilose at tip, the last ventral segment minutely punctate; petiole long, coarsely fluted, pubescent above and beneath.

♂. Length 2 to 2·5 millim. Differs principally in the filiform brown antennæ, the scape and pedicel alone being yellow; the scape is as long as the first and second funicle-joints united;

the latter are about equal in length, the second not excised at base, the joints beyond to the last being very slightly and gradually subequal; last ventral segment piceous, but with two small punctures at base.

Hab. St. Vincent.

Described from 22 male and 14 female specimens.

Tribe ii. DIAPRIINI.

GALESUS, *Curtis*.

GALESUS BIPUNCTATUS, sp. n.

♀. Length 2·2 to 2·4 millim. Polished black, impunctured, with sparse white hairs; head oblong, with a margined angulation in front of each eye, the space between it and the eye with a row of punctures; between these angulations there is another margined space enclosing the ocelli; vertex with six small punctures; face prolonged, with deep broad sulci beneath the eyes; frontal prominence with a median sulcus. Antennæ black, 12-jointed, the scape angulately dilated a little beyond the middle; flagellar joints, after the fourth, transverse-moniliform, loosely joined and gradually widened towards tip of flagellum, the last joint ovate, twice as long as the penultimate. Thorax with two furrows, the middle lobe with two small punctures at base and two at the middle; scutellum truncate and with two punctures at tip, a broad sulcus at sides and two large foveæ at base; metathorax grooved, pubescent. Wings folded, deeply emarginate at apex. Legs rufous or reddish yellow, the coxæ black. Abdomen oblong-oval, polished black; the petiole about twice as long as thick, fluted and pubescent.

♂. Length 2·5 millim. In this sex the head is shorter, only a little longer than wide, with the ridges and punctation as in the female. The antennæ are 14-jointed, filiform, as long as the body, the pedicel and first funicle-joint being brownish yellow or brown, the rest of the antennæ black; the second funicle-joint is a little thicker and shorter than the first, excised at base; the joints beyond a little longer, very little more than thrice as long as thick, the last joint being much longer than any of the others.

Hab. St. Vincent.

Described from two male and two female specimens.

Loxotropa, *Förster*.

Loxotropa columbiana, *Ashm.*

A single specimen of this species, from St. Vincent, cannot be separated from the type collected in the District of Columbia.

Loxotropa thoracica, sp. n.

♀. Length 0·8 millim. Head and abdomen polished black; thorax brownish piceous; antennæ, except the abrupt 3-jointed club which is black, and legs yellow. The head is a little longer than wide, with angulated ridges before the eyes. The first funicle-joint twice as long as the second, the following joints not longer than thick; two basal joints of club quadrate, the last oblong. Wings hyaline, pubescent. Abdomen oblong-oval, the petiole pubescent.

Hab. St. Vincent.

Described from a single specimen.

Tropidopria, *Ashmead*.

The species belonging to this genus may be separated by the aid of the following table:—

Females.

Head and abdomen black, the thorax reddish.
 Antennæ with an abrupt 3-jointed club, the last two joints being black .... *T. nigriceps*, sp. n.
Wholly reddish or dark honey-yellow.
 Antennæ with the club 5-jointed, gradually formed.
 Two last club-joints black .... *T. pallida*, sp. n.

Males.

Head and abdomen black, the thorax piceous, the petiole short, finely striate.
 Scutellum acutely triangular .... *T. triangularis*, sp. n.
Head and abdomen black, thorax reddish, the petiole long, coarsely fluted.
 Scutellum not acutely triangular .... *T. nigriceps*, sp. n.
Wholly reddish or dark honey-yellow .... *T. pallida*, sp. n.

Tropidopria triangularis, sp. n.

♂. Length 1·2 millim. Head and abdomen black, polished; thorax piceous, more or less blackish above. Antennæ 14-jointed,

pedicellate-nodose, verticillate, bright yellow, the nodes piceous. Scutellum acutely triangular, carinated, with a profound fovea at base. Metathorax rugose, carinate, subpubescent. Wings hyaline, strongly fringed. Legs, including coxæ, honey-yellow. Body of abdomen oval, black, shining; the petiole short, hardly twice as long as thick, yellowish, finely striate.

Hab. St. Vincent.

Described from two male specimens.

TROPIDOPRIA NIGRICEPS, sp. n.

♂ ♀. Length 2 to 2·5 millim. Head and thorax black, polished, impunctured; thorax reddish; the scutellum in female subobsoletely carinate, with a small fovea at base, in male with a large fovea at base and distinctly carinate; metathorax rugoso-punctate, subpubescent, the middle carina produced into a short acute spine. In the female the antennæ, except the last two joints which are black, the legs, petiole, and tip of abdomen are honey-yellow; the club is abrupt, 3-jointed; the funicle slender; the petiole about $2\frac{1}{2}$ times as long as thick, cylindrical, faintly striate; body of abdomen conic ovate. In the male the scape, pedicel, and legs are honey-yellow or reddish yellow; the flagellum piceous black, nodose-pedicellate, with whorls of long hairs; petiole coarsely fluted, fully four times as long as thick; body of abdomen oblong-oval, polished black. Wings in both sexes hyaline, strongly fringed.

Hab. St. Vincent.

Described from one female and four male specimens.

TROPIDOPRIA PALLIDA, sp. n.

♂ ♀. Length 1·8 to 2·1 millim. Uniformly light brownish red, polished; scutellum foveate at base, faintly carinate at tip; metathorax finely rugose, pubescent, with a prominent median carina. In the male the scape, pedicel, and legs are yellowish; flagellum darker, nodose-pedicellate, with whorls of long hairs; petiole $2\frac{1}{2}$ times as long as thick, finely rugose, pubescent. In the female only the last two antennal joints are black, the club being gradually formed, 5-jointed; petiole scarcely twice as long as thick, pubescent; body of abdomen pointed at tip. Wings in both sexes hyaline, strongly fringed.

Hab. St. Vincent.

Described from six male and twelve female specimens.

DIAPRIA, *Latreille.*

DIAPRIA MELLEA, sp. n.

♂ ♀. Length 1 to 1·1 millim. Dark honey-yellow or light brownish red, polished, impunctured; antennæ and legs honey-yellow. Club of antennæ in female 4-jointed, gradually formed, the last joint large, conic or oblong, black, closely joined to the penultimate, the other two joints loosely joined. Abdomen ovate, the petiole scarcely once and a half as long as thick, pubescent.

In the male the flagellum is long, cylindrical, with whorls of long hairs; the joints, except the first, all long, cylindrical, as long as the scape, the first joint only two thirds the length of the scape. Abdomen oval, the petiole a little more than twice as thick. Wings hyaline, strongly fringed in both sexes. Scutellum with a rounded fovea at base.

Hab. St. Vincent.

Described from two male and three female specimens.

TRICHOPRIA, *Ashmead.*

The following table will aid in separating the three species in this genus.

Females.

Species pale, or with thorax pale .... 2.
Species black, the pleura alone sometimes piceous.
  Pleura black; antennæ black; the club 4-jointed, loosely joined, the joints increasing in size; thickened parts of the legs piceous .... *T. insularis,* sp. n.
  Pleura piceous; antennæ, except the last three joints of club, and legs honey-yellow........ *T. pleuralis,* sp. n.
2. Thorax pale brownish piceous; head and abdomen black.
  Scutellum with two minute subobsolete foveæ at base; antennæ, except the last two joints, and legs brownish yellow .... *T. atriceps,* sp. n.

Males.

Species with the thorax pale .... 2.
Species black, the pleura alone sometimes piceous.
  Pleura black; scape, pedicel, and legs reddish yellow; second flagellar joint longer than the first, curved and angulate toward one side, the joints beyond rounded-moniliform, shorter than the first, with whorls of bristly hairs .. *T. insularis,* sp. n.

Pleura piceous; scape, pedicel, and legs honey-yellow; second flagellar joint very slightly excised at base, but not angulate, the joints beyond oval-moniliform, longer than the first, pubescent .... *T. pleuralis*, sp. n.

2. Thorax reddish, head and abdomen black.
Scutellum with a large fovea at base; flagellar joints after the second rounded-moniliform, with whorls of bristles, first joint longer than the second .... *T. atriceps*, sp. n.

TRICHOPRIA INSULARIS, sp. n.

♂ ♀. Length 1·2 to 1·3 millim. Polished black; legs piceous, the trochanters, base of tibiæ, and the tarsi yellowish. Head globose, as wide as the thorax. Antennæ 12-jointed, piceous black; scape as long as the pedicel and first two funicle-joints united; funicle 6-jointed, the joints slender, the last two a little thicker than the preceding; club 4-jointed, the joints increasing in size, the last oblong. Mesonotum not longer than wide; scutellum with a large fovea at base connected with a delicate grooved line at sides; metathorax short, finely rugose, with a median carina, and subpubescent. Wings hyaline, strongly fringed. Abdomen ovate, pointed at tip, polished black, the tip piceous, with sparse long hairs; petiole cylindric, twice as long as thick.

In the male the antennæ are 14-jointed, filiform-moniliform, pale brownish, the scape and pedicel yellow; second flagellar joint a little longer and stouter than the first, curved and angulate towards one side; the joints beyond to last rounded-moniliform, shorter than the first, all with whorls of stiff bristles; legs, including coxæ, reddish yellow; petiole not longer than thick, pubescent; body of abdomen oval.

Hab. St. Vincent.

Described from one male and one female.

TRICHOPRIA PLEURALIS, sp. n.

♂ ♀. Length 1 to 1·2 millim. Closely resembles *T. insularis*; but in the female the antennæ, except the 4-jointed club, the legs, and the abdominal petiole are yellow; the mesothoracic pleura piceous; the petiole is not longer than thick and pubescent; while the male differs in having the flagellum brown, the joints after the second oval-moniliform, longer than the first, with a short pubescence, the second joint being only slightly excised at base, and not angulate.

Hab. St. Vincent.

Described from one male and one female.

TRICHOPRIA ATRICEPS, sp. n.

♂ ♀. Length 1·3 to 1·5 millim. Head and abdomen polished black; thorax pale brownish piceous or reddish; antennæ in female (except the last two joints of the club) and the legs yellow or pale brownish yellow. Head a little longer than wide, subglobose. The antennæ end in a 3-jointed club, the joints increasing in size, the last joint oblong; funicle slender, 7-jointed, the joints scarcely longer than thick. Collar, metathorax, and the short petiole woolly. Scutellum smooth, with two minute subobsolete foveæ at base. Body of abdomen conic ovate.

The male (or what is taken to be the opposite sex) is larger, and agrees in colorational detail with the female; but the antennæ are 14-jointed, filiform-moniliform, the first flagellar joint being a little longer than the second, the second slightly swollen, the joints beyond rounded-moniliform, with whorls of long bristles, while the scutellum has a large, smooth, shallow fovea at base.

Hab. St. Vincent.

Described from one male and two female specimens.

PHÆNOPRIA, *Ashmead.*

Two species in this genus have been recognized as follows:—

Females.

Dorsal abdominal segment 5 much longer than 3 and 4 united.
- Antennæ black; swollen parts of legs piceous.... *P. subclavata*, sp. n.

Dorsal abdominal segment 5 not longer than 3 and 4 united.
- Antennæ, except the scape and club, honey-yellow; legs bright yellow, tips of femora and tibiæ piceous.................................. *P. simillima*, sp. n.

Males.

Basal 3 joints of antennæ yellow, the flagellar joints after the second rounded-moniliform.
- Legs honey-yellow...................... .... *P. subclavata*, sp. n.

Basal joint of antennæ yellow, the flagellum brown-black, the joints after the second oval.
- Legs and petiole yellow, tips of femora and tibiæ piceous.................................. *P. simillima*, sp. n.

PHÆNOPRIA SUBCLAVATA, sp. n.

♂ ♀. Length 1 to 1·2 millim. Polished black, impunctured; antennæ in female 12-jointed, black, enlarged towards tip, the funicle-joints after the second a little transverse, very gradually increasing in width to club; club 3-jointed, the first two joints nearly equal, transverse, the last oblong, as long as the two preceding together, and stouter; legs piceous, the trochanters, base of tibiæ, and tarsi yellow. Scutellum longer than wide at base, convex, without a fovea at base. Metathorax and petiole pubescent, the latter short. Abdomen conic-ovate, as long as or a little longer than the thorax, the last segment conical, 5th segment much longer than the 3rd and 4th united. Wings hyaline, strongly fringed.

In the male the first three or four basal joints of antennæ and the legs are yellow; rest of the antennæ pale brownish, the flagellar joints after the second rounded-moniliform, with bristly hairs; the second joint is a little longer than the first, very slightly bent; body of abdomen oblong-oval, truncate at tip.

Hab. St. Vincent.

Described from two male and two female specimens.

PHÆNOPRIA SIMILLIMA, sp. n.

♂ ♀. Length 0·65 to 0·90 millim. Differs from *P. subclavata* in its smaller size and colour of antennæ and legs; the antennæ in the female, except the scape and the club, are pale yellow; the swollen parts of the legs are piceous; while the 5th abdominal segment is not longer than the 3rd and 4th united.

The male differs in having the scape alone yellow, the flagellum being black, with the joints after the second elliptic-oval, not rounded; the second joint is a little thicker than the first and very slightly excised at base.

Hab. St. Vincent.

Described from one male and one female.

ADDENDUM.—On p. 77, for *Anectoclis* sp. read *Anectoclis rufipes*, Howard.

On Mediterranean and New-Zealand *Reteporæ* and a Fenestrate Bryozoa. By Arthur Wm. Waters, F.L.S.

[Read 1st November, 1894.]

(Plates VI. & VII.)

Our knowledge of the Mediterranean *Reteporæ* is most unsatisfactory, as so many specific names have been given on account of slight differences in the nature of the reticulation; and when preparing a detailed list of Bryozoa found near Rapallo *, the specimens examined in several cases did not correspond with published descriptions, so that an entire re-examination of Mediterranean *Reteporæ* seemed desirable. The reason for a more careful examination of the value of various points was increased upon receiving from Professor Parona, of Genoa, a most interesting fenestrate Bryozoa, which, at the first glance, seemed to belong to *Retepora*, whereas, upon consideration of the characters of the *Reteporæ*, it is not placed with them but described as *Palmicellaria parallelata*, though with much doubt as to whether it should not be made the type of a new genus.

The genus *Retepora* was first established on account of the anastomosing reticulate zoarial growth; but it has become quite clear that this is not a satisfactory character, since species have been found which are simply foliaceous with the zoœcial features of *Retepora*. Although our ideas of the importance of reticulation have quite changed, I maintain that we have here a natural group based upon zoœcial characters, though unaware of any one character which is absolutely constant.

The branches usually anastomose, the non-zoœcial face of the zoarium is usually relatively thick, with lacunæ in the shell-structure, and this *dorsal surface* is separated into areas by vibices; but these areas, as a rule, in no way correspond with the zoœcial divisions, whereas in *Petralia* and in what I now call *Palmicellaria parallelata* the divisions on the dorsal surface simply mark off the boundaries of the zoœcia †.

There is usually a *labial fissure or pore*, and this I should

* I hope that the results of some work done in Rapallo, near Genoa, will shortly be published, but an irritation of the eyes has caused delay.

† In the fossil *Retepora elegans*, Reuss, from the Bartonian of Italy, the zoœcial divisions are also shown on the dorsal surface.

consider one of the most important features of the genus. This pore is frequently the opening of a long tube which runs down the peristome close to the opercular opening. At one time I thought that it sometimes opened on the zoœcial side of the operculum, but I have not been able to satisfy myself that this is the case. The tube of this sublabial pore can be most distinctly seen in *Retepora fissa* (Pl. VII. figs. 21 and 22). In *Retepora Imperati*, Busk, from Porto Praya, I am unable to find it in calcined specimens in my possession; whereas in *R. Solanderia*, which is so closely related as to leave it doubtful whether it might not be placed as a variety, the pore is distinctly visible. In a specimen of *R. cellulosa* from the North Cape there are very frequently (Pl. VI. fig. 17) two such pores, one on each side.

The *ovicells* are usually raised and nearly always have a more or less fissured opening. There is the plain narrow fissure of the *R. cellulosa-fissa* group; the wide fissure of the *R.-Imperati* group; and the irregular denticulate fissure of the *R.-monilifera* group (see pl. iii. fig. 11 of my 'Challenger' Supplementary Report). In spite of considerable difference in the appearance of the ovicells in the three groups they are seen to pass through various gradations, showing in reality similarity of structure. The *R. elongata*, Smitt, however, has an entire ovicell, which when mature is either straight below or has a slight peak, as in fig. 9, while in the younger ovicells the opening is thrown much further back. The ovicells of *R. tessellata*, var. *cæspitosa*, Busk (Pl. VI. figs. 7, 8), show a similar difference in young and mature ovicells.

The *suboral glands* *, to which I have called attention, seem to be well developed throughout the genus. Preparations made where there was suitable material show them in all cases; and I have now seen them in *R. avicularis*, *R. cellulosa*, *R. columnifera*, *R. contortuplicata*, *R. Couchii*, *R. denticulata*, *R. elongata*, *R. gigantea*, *R. jacksoniensis*, *R. mediterranea*, *R. tubulata*, &c.

It would seem that these glands occur quite generally through the Schizothyriata of Gregory and possibly may give us assistance in classification. I hope shortly to publish further observations on these organs, which we may have to compare with the excretory organs described by Cori in the Phylactolæmata. A form described

* 'Challenger' Supp. Rep. vol. xxxi. p. 27; and "Observations on the Gland-like Bodies in the Bryozoa," Journ. Linn. Soc., Zool. vol. xxiv. p. 272.

by Mr. Kirkpatrick as *R. sinuosa* * differs in several respects from other *Reteporæ*. The aperture and ovicell resemble those of *Lepralia*, while there are semicircular avicularia somewhat like those found in *R. granulata*, *R. producta*, &c.; the dorsal surface is vibicated, and the markings on the solid dorsal structure are independent of the zoœcia. Although we may feel uncertain as to its ultimate destination, there does not seem sufficient reason at present for removing it from *Retepora*.

Another very curious form is mentioned by Mr. Busk † as existing in the Oxford Museum, differing from all known *Reteporæ* in being bilaminate. The opercula and mandibles are said to be exactly the same as those of *Retepora tessellata*. Without further examination it would be impossible to say where it should be placed. Mr. Busk proposed for it the name *R. escharoides*.

Dr. J. W. Gregory has proposed a new genus, *Schizoretepora*, for those species which have a sinus ‡, *R. tessellata* being mentioned as the type, and these in his classification are not only placed in a different family to *Retepora* but even in another suborder. Careful suggestions regarding classification, like those of Dr. Gregory, are useful as showing the direction in which attempts should be made, and our knowledge of the Bryozoa is yet so imperfect that we need not be surprised when weak points are discovered. If forms showing similarity in so many important zoœcial and zoarial characters should have to be placed in two distinct suborders, there would be reason for despairing of ever obtaining a satisfactory classification, and therefore the group called *Schizoretepora* should receive our careful consideration.

This group, of which *R. tessellata* is taken as the type, includes *R. Imperati*, Busk, *R. elongata*, Smitt, *R. Solanderia*, Risso; and in all these there is apparently a small sinus, but the opercula of none have any projection on the lower border to fit into a sinus, whereas in *Schizoporella* the opercula and aperture correspond. Further examination shows that there are two teeth in the aperture of this group of *Retepora*, giving the illusive appearance of a sinus. The opercula should, however, whenever it is possible, be examined, as the shape of the aperture may in some cases be misleading, and on this account there is a certain element of uncertainty in the study of fossils. The shape of the opercula,

* Allied to *R. plana*, Hincks, Ann. & Mag. Nat. Hist. ser. 6, vol. ii. p. 269.

† 'Challenger' Report, vol. xxx. p. 114.

‡ "On the British Palæogene Bryozoa," Trans. Zool. Soc. vol. xiii. p. 224.

as figured by Busk for *tessellata* vars. and by me for what I consider a variety of *P. Imperati*, shows that there has not been a true sinus.

There is, however, another *Retepora*, the *R. formosa*, with a sinus into which the operculum fits. This belongs to the *R.-monilifera* group, and besides having the *monilifera*-form of the ovicell, has so many other minute characters of *Retepora* that it would require a good deal of courage to remove this into another genus, to say nothing of another suborder.

To return to the *R.-tessellata* group, the only member in which the sublabial pore is known is *R. Solanderia*, and here it is very distinct; while in *R. Imperati*, which so closely resembles it in most particulars, none is found. It should, however, be repeated that the existence of this pore characteristic of most *Reteporæ* in one member of the group may be taken as showing the close relationship to the others.

We next come to the consideration of the genus *Reteporella*, Busk, of which two species were described in the 'Challenger' Report, three by Ortmann *; then there is *R. Worsleyi*, MacG. †; and if we recognized the genus, *R. Solanderia* would be placed there also. The sole reason given for separation is that these are non-reticulate; but the three species of Ortmann approach so nearly to known *Reteporæ* in shape of aperture, ovicell, and other characters, that we are in doubt as to whether they should even be separated specifically. In *Retepora Solanderia* the aperture, ovicell, avicularia, &c. are truly Reteporidan, showing a very close resemblance to *R. Imperati* in nearly all particulars; and I maintain that if we placed these two in different genera on account of the one being reticulate and the other not, we should be going back to the time when almost all genera were based upon zoarial characters, and *R. Solanderia*, even if considered alone, would give sufficient reason for dropping the genus *Reteporella*.

We have seen that this species would by Busk be placed in *Reteporella*, whereas Gregory would place it and the allied but reticulated species under *Schizoretepora*. As before said, I have not seen sufficient reason to remove it from *Retepora*; and certainly, if it was found advisable to make a new genus for the

* "Japanische Bryozoenfauna," Archiv für Naturgeschichte, vol. i. 1890, p. 36.

† "Descriptions of New or Little known Polyzoa," Trans. Roy. Soc. Vict. vol. xxiii. p. 185.

R.-tessellata group, they would have to remain in the same family as *Retepora*.

The genus *Retepora* is found fossil throughout the Tertiaries, but does not seem to occur in the Cretaceous period.

RETEPORA CELLULOSA, *L.* (Pl. VI. figs. 17 & 20; Pl. VII. fig. 12.)

Retepora cellulosa, *Smitt, Krit. Fört. öf. Skand. Hafs-Bryozoer*, iv. 1867, pp. 35 and 203, pl. xxviii. figs. 222–225.

Although so many authors have mentioned *R. cellulosa*, there does not seem to be any satisfactory description, most having apparently had two or three forms before them; and out of the very long list of synonyms usually quoted, I cannot find more than the single one above given which can be relied upon. Such figures as those of Ellis, Lamouroux, and Blainville will do equally well for two or three species; and no doubt Busk, in his 'Catalogue of the Marine Polyzoa,' figured more than one. Quotations from such works as Lamarck's 'Animaux sans Vertèbres,' where for *R. reticulata* and the other species no single zoœcial character is mentioned, only waste time by causing useless references; and in this special case, though no doubt the figure quoted by Lamarck is that of *Frondipora verrucosa*, it has been considered as a synonym of *R. cellulosa*. Risso describes it as "*presque membraneux.*"

Out of the Mediterranean species there is one which we must now consider as the type, without being at all sure that this is the one which was in the hands of those who first gave the name. It is not a stout species, and I have not often seen it grow to any considerable size, but usually the colony is cup-shaped. The peristome is but little raised, with a spine at each corner; it has a distinct sublabial pore, which, however, seems to have been mistaken for an avicularium by some authorities, including apparently Busk in his 'Crag Polyzoa.' The operculum becomes much wider at the proximal border.

There is no avicularium within the peristome, and in this respect it differs from *R. atlantica*, Busk, and *R. mediterranea*, Smitt; but there are numerous small avicularia scattered over both the front and dorsal surface; a few large erect avicularia occur with the opening directed to the distal end of the zoœcium.

The ovicell has a fissure in the calcareous wall, which of course is covered by an integument, and is identical in structure with those of *R. Beaniana*, *R. atlantica*, *R. mediterranea*, *R. fissa*. The front

wall of the ovicell is prolonged below into a kind of lamina, subtruncate at its lower extremity, which extends some way into the aperture. This is a character which Hincks mentioned when describing his *R. prætenuis* (=*R. marsupiata*, Sm.), and is found in this group in *R. cellulosa*, *R. atlantica*, *R. complanata*, and to a certain extent in *R. Beaniana*, but not in *R. mediterranea*, *R. aporosa*, and *R. fissa*, in which last the front wall ends higher up and is straight. In *R. monilifera*, var. *munita* and *umbonata*, the front wall is prolonged in the same way, but has a cleft or sinus at the end of the lamina (see Pl. VII. fig. 20) forming a squarer opening.

The fenestral avicularium is found at the angle of most fenestræ, but not of all; similar fenestral avicularia occur in a large number of species of *Retepora* and are also found in *Petralia*. As a rule in *Retepora* they occur on the dorsal surface at the angle of the fenestræ, but they are sometimes on the front, as in *R. monilifera*, var. *munita*.

The dorsal surface has the vibices more or less longitudinal and more numerous than in *R. mediterranea*.

In a specimen from the North Cape the large erect avicularium has a distinct beak, and at the sides there are two projecting wings (Pl. VI. fig. 17). The mandible has a larg lucida, which Mr. Busk described as a foramina; but as it is caused by the chitin being here thinner, I have elsewhere proposed the name *lucida* *. This *lucida* is figured by Busk surrounded by a second oval, as if there were a thick band; but this structure I have not found in the mandible of any, and have added a figure from a specimen sent to me from the North Cape, the mandibles of which are similar to those from Naples, Rapallo, and Capri.

Smitt placed *R. Beaniana* as "forma" of *R. cellulosa*, and certainly it is very difficult to separate the group. The oral avicularium may be at the end of a long rostrum, as in typical *R. Couchii*; it may be shorter, as in *R. Beaniana*, or within the oral aperture, as in *R. mediterranea*, or absent, as in *R. cellulosa*. Intermediate stages are found in a series of specimens, and very slight changes would evolve the one from the other. Busk speaks of a prominent rostrum having a minute avicularium on one side at the base, but this I have not seen.

* Ann. & Mag. Nat. Hist. ser. 5, vol. xx. p. 84.

RETEPORA COUCHII, *Hincks*.

From Rapallo there are specimens with large fenestræ, as in Naples specimens, and there are others with very small meshes; and, in fact, this species shows us very clearly that too much importance must not be attached to size and shape of the meshes. Usually the fenestræ are about 2 mm. long, 0·8–1 mm. wide, and the branches are 0·4 mm. wide; whereas the smaller form from Rapallo has the meshes 0·8 mm. long, 0·4–0·6 mm. wide, and one from Roscoff, sent by Joliet as "*cellulosa*," has the meshes only 0·6 mm. long and 0·2 mm. wide, with the branches 0·4 mm. wide.

Although there may be a considerable range in the size of the fenestræ, yet there is in most a typical form which should be described, and therefore the following table, prepared from specimens in my collection, may be useful for comparison:—

	Fenestræ.		Proportion.	Branches.
	Long.	Wide.		Wide.
RETEPORA-CELLULOSA GROUP.	millim.	millim.		millim.
R. cellulosa, *L.*; Naples	1·0	0·6	1–0·6	0·6
do. Zoagli	0·9	0·4	1–0·4	0·5
do. N. Cape	1·2	0·4	1–0·3	0·6
complanata, *Waters*	2·0	0·8	1–0·4	0·6
mediterranea, *Smitt*	1·6	0·8	1–0·5	0·8
aporosa, *Waters*	1·8	0·8	1–0·4	0·5
Couchii, *H.*; typical	2·0	0·8	1–0·4	0·4
do. Roscoff	0·6	0·2	1–3	0·4
do. Rapallo	0·8	0·4–0·6	1–0·4 to 0·5	0·6
do. var. biavicu-lata, *W.*	2·0	0·8	1–0·4	0·4
do. do.	1·2	0·4	1–0·3	0·6
Beaniana, *King*	1·0	0·6	1–0·6	0·6
producta, *B.*	3·6	0·6	1–0·17	1·2–1·4
fissa, *MacG.*	1·2	0·3	1–0·25	0·6
atlantica, *B.*; Chall.	1·4	0·6	1–0·4	0·5
jacksoniensis, *B.*	1·4	0·6	1–0·4	0·6
porcellana, *MacG.*	1·8	0·6	1–0·3	1·2
RETEPORA-MONILIFERA GROUP.				
R. umbonata, *MacG.*	1·0	0·6	1–0·6	1·2
munita, *MacG.*	1·0	0·4–0·6	1–0·4 to 0·6	0·8
columnifera, *B.*	0·8	0·7	1–0·9	0·5
victoriensis, *B.*	0·6	0·4	1–0·6	0·8
contortuplicata, *B.*	1·0	0·6	1–0·6	0·6
columnifera, *B.*	0·8	0·7	1–0·9	0·5
tubulata, *B.*	0·6	0·4	1–0·6	0·4–0·6
formosa, *MacG.*	0·8	0·4	1–0·5	0·6

TABLE (*continued*).

	Fenestræ. Long.	Fenestræ. Wide.	Proportion.	Branches. Wide.
RETEPORA-TESSELLATA GROUP.	millim.	millim.		millim.
R. Imperati, *B.*; Chall. ...	2·4	1·0	1–0·4	0·6
elongata, *Sm.*	4·0	1·0	1–0·25	1·0
Solanderia, *Risso*	...	...	...	0·8–1·2
RETEPORA WITH LEPRALIOD OPERCULUM.				
R. sinuosa, *Kirkp.*	1·0	0·7	1–0·7	1·5
novæ zelandiæ, *Waters* ...	0·8	0·4	1–0·5	0·8
UNCERTAIN POSITION.				
R. gigantea, *B.*..................	4·0	2·0	1–0	1·0
magellensis, *B.*	2·2	1·0	1–0·45	1·0
lata, *B.*	0·7	0·4	1–0·57	0·9
avicularis, *MacG.*	1·8	0·5	1–0·3	0·4

RETEPORA COUCHII, var. BIAVICULATA, var. nov. (Pl. VI. fig. 18.)

In a *Retepora* from Naples sent to me named *R. reticulata*, Lamk.*, the two prongs of the peristome each carry a small round avicularium at the end, whereas in normal *R. Couchii* the "wing-like processes" of Hincks do not bear an avicularium; on the other hand, the labial and oœcial fissures and other characters correspond with those of *R. Couchii*.

This variety I have since found in the material I collected from Naples and also from Capri, and further fossil from the Upper Tertiaries of Testa del Prado, near Reggio, Calabria, but in this case with the meshes about half the size of the living specimens.

RETEPORA COUCHII, *H.*, var. APOROSA, nov. (Pl. VI. fig. 22.)

Specimens from Rapallo have a rostrum which sometimes carries an avicularium, but more often it is merely a barren process. There is no labial fissure or pore, nor is the peristome as much developed as is usually the case in *R. Couchii*; on both the anterior and dorsal surfaces there are small oval avicularia;

* The description of *R. reticulata* given by Lamarck was quite insufficient, while the figure to which he referred represents *Frondipora verrucosa*.

the fenestræ are moderately uniform and about the size of typical *R. Couchii*; the ovicells are turned inwards at the lower border, which is nearly straight and does not form a "lamina"; there are no oral spines; in the oral aperture there is a small denticle at each side. The operculum is very thin, and does not widen out at the proximal edge in the same way as the Mediterranean *R. cellulosa*. There are no fenestral avicularia, and the vibices are more or less parallel.

In my Supplementary 'Challenger' Report I referred to the dorsal calcareous processes of *Retepora* growing over the chitinous tubes of *Caberia*, and in the present species there are similar rooting-processes growing over fibres of seaweed, also a few such processes are thrown out from the front surface.

Retepora complanata, sp. nov. (Pl. VI. fig. 21; Pl. VII. figs. 14–18.)

This in most respects resembles *R. cellulosa*, but the dorsal surface is much flatter and usually has the vibices more or less parallel to the long axis of the fenestræ; and from the Naples and Capri specimens in my possession the zoarium seems to have been but little convoluted. On the dorsal surface there is a fenestral avicularium.

One piece (Pl. VII. fig. 14) has an ovicell to each zoarium, while another (fig. 18) has none, giving a remarkably different appearance to the colonies. The sublabial pore is well developed, and there is a spine at each side of the oral aperture. There is no avicularium on the lower lip, but numerous small avicularia, both oval and triangular, are scattered over the zoaria, also there are a few large raised avicularia with narrow triangular openings.

The opercula and mandibles are similar to those of *R. cellulosa*, and perhaps this should only be considered a variety.

Hab. Naples, 80 fath.; Capri.

Retepora mediterranea, *Smitt.* (Pl. VI. figs. 14, 15, 16.)

Retepora cellulosa, forma Beaniana, var. mediterranea, *Smitt, Krit. Fört. öfver. Skand. Hafs-Bryozoer, Vetensk. Ak. Förhand.* 1867, pp. 35, 202 note; *M.-Edwards in Cuvier, Règ. An., Zooph.* pl. lxxxvii. fig. 1 *a–e* (fide *Smitt*).

Retepora cellulosa, *Waters, Ann. & Mag. Nat. Hist.* ser. 5, vol. iii. p. 199, pl. xv. figs. 1, 2; *id. Trans. Manchester Geol. Soc.* vol. xiv. p. 479.

The zoarium is large, probably in most cases cup-shaped, chalky white; reticulations moderately regular; branches round; meshes about 1·6 mm. long, 0·8 mm. wide; branches about 0·8 mm. wide.

Zoœcia only slightly raised, smooth, without any large avicularia, but with a small one (with a semicircular mandible) in the aperture, and small round ones over the surface. The oral aperture is straight on the proximal end and becomes much wider towards this edge. There is a denticle on each lateral wall of the oral aperture. The dorsal surface is slightly granular and has few vibices, and these usually cross the branch near the end of the fenestræ. The ovicells as a rule are not much raised, in fact are often only recognized by the cleft.

This seems to be common near Naples and Capri, and I have it fossil from the Pliocene of Bruccoli (Sicily) and Testa del Prado (Calabria). In the shape of the operculum, in having an avicularium within the aperture, and in structure of the dorsal surface it approaches closely to *R. Beaniana*, though even in these characters there is a slight difference between the two. Further the zoarium is much stouter than in the northern *Beaniana*, and the avicularium is placed diagonally within the aperture, nor is there any rostrum or avicularium, and of course the denticles projecting from the rostrum or avicularium of *R. Beaniana* are wanting.

In *R. atlantica*, B., from station 75 of the 'Challenger,' some zoœcia have a small round avicularium on the lip of the aperture, while others have a rather large triangular one, showing that too much importance must not be attached to the shape of the avicularium. I do not think this is the *R. cellulosa* of Van Beneden, which has a large erect avicularium.

RETEPORA SOLANDERIA, *Risso*. (Pl. VI. figs. 1–4.)

Retepora Solanderia, *Risso, Hist. Nat. de l'Europe Mérid.* vol. v. p. 344.

Retepora arborea, *Jullien* (non *Risso*), *Bryozoaires Dragages du Travailleur, Bull. Soc. Zool. de France*, vol. vii. p. 21, pl. xvi. figs. 49, 50.

Zoarium branched in one plane, not usually reticulated, branches thick. The zoœcia on each side of the median line have a large avicularium on a raised rounded avicularian chamber, with the mandibles directed inwards. The outer zoœcia have no avicularia, the terminal zoœcia have spines. Labial pore distinct, with a slight fissure. Ovicells cucullate, with a wide opening. The dorsal surface has regular vibices, and in each area there is a large raised avicularium somewhat similar to those upon the front, usually directed outwards, but also occurring in various positions. On the dorsal surface there is frequently at the junction of two branches a large avicularium with triangular mandibles. This is the equivalent of the fenestral avicularia

which are common in the *Reteporæ.* All my specimens were dead, and no chitinous appendages were found.

This *Retepora* is common in the material brought up from about 225 fathoms by the coral-fishers near Capri, but I have not seen it from Naples or Rapallo. It does not show any reticulation, so that if Busk's genus *Reteporella* were recognized it would have to be placed in it; but the advisability of dropping the genus *Reteporella* is clearly indicated by this species, and is quite borne out by the three species so classed by Ortmann *, as in zoœcial characters they very closely resemble known species.

Probably this is the species which Risso described with "*rameaux cylindriques nullement entrelacés*," and named *Retepora Solanderia*; but as the characters to which we should now give most attention are omitted, this is not clear.

Retepora arborea, Jullien, is described as finely reticulated on both the anterior and dorsal surface, but in all other respects the 'Travailleur' and Mediterranean specimens agree. The name *arborea* was previously employed by Risso, and therefore cannot now be used, although we cannot be sure what Risso had before him; perhaps it was *Reticulipora dorsalis*, Waters.

The zoœcial characters are in many respects the same as those of *R. Imperati*, Busk; but, as mentioned in my Supplementary 'Challenger' Report, I have not seen any reticulating *R. Imperati* from the Mediterranean, but perhaps in some cases there may be foliaceous or reticulate growth according to the conditions of the locality. The *R. Imperati*, Busk, of the 'Challenger' from Porto Praya, usually has the avicularia to the central zoœcia, and has large avicularia on the dorsal surface.

A group may be made round *tessellata* including *R. elongata* (= *R. tenella*, Ortmann), *R. Imperati*, Busk (= *R. tumescens*, Ortmann), *R. Solanderia*, Risso, which, so far as known, have a very characteristic operculum †. In this group the ovicell is widely open, more or less cucullate, and a considerable distance from the opercular aperture; in *R. tessellata* (Pl. VI. fig. 6), *R. Imperati* (Pl. VI. fig. 5), and *R. Solanderia* the opening extends far up with parallel sides, so that it has somewhat the form of a wide fissure, and we may see how from this, or *vice versâ*, the

* Ortmann, A., "Die Japanische Bryozoenfauna," Arch. für Naturgesch. vol. i. 1890, p. 36.

† The operculum of *R. tessellata*, var. *cæspitosa*, Busk, is drawn reversed in three cases in the 'Challenger' Report.

narrow fissure of *R. cellulosa* might be developed. In *R. elongata* (fig. 9) the lower edge is straighter, with a central tooth, but in the younger zoœcia (fig. 10) the ovicell has at first a wide circular opening; nor is this age difference peculiar to this species, for in many cases the opening in the ovicell is larger in the young than in the older ovicells. There are in all very large triangular avicularia on the anterior surface of the zoarium, usually directed alternately. Only in *R. Solanderia* is there a sublabial pore, very distinct; while in *R. Imperati*, which so closely resembles it in most particulars, none can be found: thus an important feature of the other groups of *Retepora* is found in one member of the present group.

The mandibles in this group are, so far as I am acquainted with them, all of the same type. They all have a round or oval part much thinner than the rest, which I have called a lucida, and this varies in size and position according to the species.

Palmicellaria parallelata, sp. nov. (Pl. VI. figs. 11–13, 19.)

Zoarium in one plane, fenestrate, with cylindrical biserial branches, parallel to one another, and joined at more or less regular intervals by barren tubular trabeculæ starting from near the distal end of the zoœcium. Zoœcia cylindrical, distinct; surface smooth, transparent, vitreous, distal end but slightly raised; opercular aperture orbicular, operculum thin membranous, no labial pore or fissure; immediately below the aperture a long rostrum nearly the length of a zoœcium with an avicularium near the base directed outwards; mandible semicircular. Ovicell globose, prominent, slightly elongate and somewhat flattened in front, very finely pitted, with a perforation in the centre of each pit. Dorsal wall similar to the anterior, thin, transparent, smooth, showing the zoœcial walls distinctly. The zoœcia are placed alternately, and on the dorsal surface at the distal end there is a round raised disk with a round opening in the centre.

At the side of the branch where the distal and proximal zoœcia join there is a round area (Pl. VI. fig. 13, *a*), with walls sloping to the junction of the two zoœcia, and each of these walls carries a rosette plate. The trabeculæ start from such an area, so that we may say in each zoœcium there is the preparation for a trabeculum, though one is only developed to every two or three zoœcia. The external lateral wall of the zoœcium has a row of small pores.

The specimen kindly given to me by Professor Parona of Genoa was obtained in Naples, and at first sight was placed with *Retepora* and named *R. parallelata*.

Although Busk has described three species of *Retepora* which sometimes have barren trabeculæ *, they cannot be compared with the present form, and the thin shell-structure and the absence of any labial pore or fissure soon showed that it should not be placed with *Retepora*. The structure of the zoœcium being so similar to that of *Palmicellaria*, it has been a question whether to call it *Palmicellaria parallelata* or to create a new genus and name it *Parallelata vitrea*; but under either name it can be easily recognized again, and its position determined when more material has been compared. The form of the ovicell is different to any that I am acquainted with in *Retepora*.

The disks on the dorsal surface (Pl. VI. fig. 11) resemble those on *Scrupocellaria*, and suggest that rooting processes may be thrown out from these disks, though I find no trace of this in my specimen †, which, though preserved in spirit, had evidently been dead some time, and there were no polypides.

Living reticulated forms are known in several genera, as *Petralia* (*undata*), *Flustra* (*cribriformis*), *Retehornera*, several *Idmoneæ*, as *I. Milneana*, *I. interjuncta*, *I. flabellata*, Kirchenpauer, the last three being joined by barren tubes, while *Bugula reticulata* throws out connecting tubes. In the Chalk there are several others; and when more importance was attached to zoarial characters, the *Fenestellidæ* were classed with *Retepora*, though they have now long been separated.

The zoarial resemblance of the species now under consideration to *Fenestella* will naturally strike any one. The family *Fenestel-*

* 'Challenger' Report on the Polyzoa, pt. xxx. p. 108.

† Many instances are known where these disks, or, as we may call them, radicle chambers, are found in some zoœcia without any chitinous tube growing from them. In the Cellulariidæ various examples might be cited, and *Alysidium Lafontii* is a most interesting one, for these radicular disks on the dorsal surface near the distal end have been correctly figured by Savigny, Busk, and others; but no reference has been made to them, nor does the structure seem to have been understood. These disks are always present; but, after the examination of a great many specimens, I have only found the rooting-processes growing from one small specimen from Trieste and a small one from the Gulf of Taranto. Dr. A. Neviani, in the 'Rivista Italiani di Paleontologia' (April 1895), has published descriptions of two fossils from the Pliocene or post-Pliocene of the Farnesina, which he calls *Vibraculina*; and *V. Conti*, Neviani, is apparently identical with the Naples form, although in the fossil it has not been possible to make out all the structure, and the name *Vibraculina* would not be suitable, as we now see that there are no vibracula.

lidæ, according to some, only includes forms which have two zoœcia in a row, the branches being united by barren dissepiments; others would also place in the family those which have several rows of zoœcia. At any rate, our Naples specimen in these respects resembles typical *Fenestella*, but when other characters are examined we see that the striking resemblance is merely zoarial. The dissepiments are tubular, which, so far as I can make out from published figures and from specimens in my collection, is never the case in *Fenestella*; as to the value of this point we are scarcely in a position to form an opinion, whereas the differences in the shape of the zoœcium are of more importance.

In 1878 I pointed out that in one species of *Fenestella* there are two denticles in each cell *, and Ulrich, in his 'Palæontology of Illinois,' has shown that these denticles are largely found in the Cryptostomata, a suborder proposed by Vine; and to repeat what I have elsewhere said †, these denticles are usually at the base of what Vine ‡ and Ulrich § call a "vestibule,"—that is to say, there is within the shell a tubular shaft up to the external opening, so that it is at right angles to the "primary chamber," which might be called the zoœcial chamber.

There are several recent Chilostomata which have zoœcia the shape described as occurring in Palæozoic Cryptostomata, among others *Childonia Cordierii* may be mentioned, and there are some which have a hemisepta at the point of attachment of the operculum; so that there seems very strong reason for following Ulrich in considering that the Cryptostomata, including *Fenestella*, show closer relationship to living Chilostomata than to Cyclostomata. Now when we compare the shape of the zoœcia of *P. parallelata*, we find none of the characters of Cryptostomata and there are no hemisepta.

There is no affinity between *Retepora* and *Fenestella*, although with regard to zoarial characters both may be fenestrate with dissepiments, or reticulate through the branches anastomosing, while a few are simply branched.

The *Retepora deserta*, Waters, which I described ‖ fossil from Bairnsdale, has somewhat the same structure as *Palmicellaria parallelata*.

* "Remarks on some Fenestellidæ," Manchester Geol. Soc. vol. xiv. 1878.

† Ann. & Mag. Nat. Hist. ser. 6, vol. viii. p. 50.

‡ Quart. Journ. Geol. Soc. vol. xl. p. 332.

§ "Palæozoic Bryozoa," Palæontology of Illinois, vol. viii. 1890.

‖ Quart. Journ. Geol. Soc. vol. xxxviii. p. 511.

New Zealand.

The only reference, so far as I am aware, to New-Zealand *Reteporæ* is in Hutton's 'Catalogue of Marine and Land Shells,' &c. p. 195, where *R. cellulosa* is said to have been found off Chatham Island, New Zealand; but seeing how unsatisfactory the descriptions of *R. cellulosa* are, it may be doubted whether it has been found in the southern hemisphere.

Miss Jelly has lent me specimens of *R. fissa*, which occurs in Victoria, N. S. W., and Tasmania. Of two species of *Retepora* in my collection, both of which were given to me by Miss Jelly, one is new and the other appears to be a form of *R. monilifera.*

Retepora monilifera, forma munita, *Hincks*. (Pl. VII. figs. 7–11.)

A colony of much convoluted *Retepora* belongs to the group of *R. monilifera,* though the absence of ovicells leaves the determination somewhat unsatisfactory. The peristome is very slightly raised, there is a suboral pore, and a small triangular avicularium on the peristome by the side of the pore; besides this there are three kinds of avicularia scattered abundantly over the anterior surface—(1) a long triangular one, usually without a bar, (2) a small semicircular one, (3) a small oval one; and there is also a large semicircular avicularium near the angle of a fenestra on the anterior surface. On the dorsal surface there are small oval avicularia, and these are especially numerous within the fenestræ. The opercula are very thin, which is not the case with my Australian specimens of *munita.*

The vibices are few, meeting in the middle or crossing over the branch, and there are no dorsal fenestral avicularia.

The small avicularium on the peristome resembles those on *R. porcellana, R. monilifera, R. aurantiaca, R. granulata.*

Hab. Victoria; South Australia; New Zealand; and var. *japonica,* B., from Japan.

Retepora fissa, *MacG.* (Pl. VII. figs. 21, 22.)

Retepora fissa, *MacG. Trans. Roy. Soc. Vict.* vol. ix. p. 140, and vol. xix. p. 291, fig. 8; *Zool. Vict.* dec. x. p. 17, pl. xcv. figs. 12–16; *Waters, Ann. & Mag. Nat. Hist.* ser. 6, vol. iv. p. 18.

Miss Jelly has kindly lent me specimens from New Zealand which Mr. Busk had named *R. maorica,* MSS., and another which

had come into her possession marked *R. Colensoi*, Busk, MSS. Both these entirely correspond with the Australian *R. fissa*, now known from Victoria, New South Wales, Tasmania, and New Zealand.

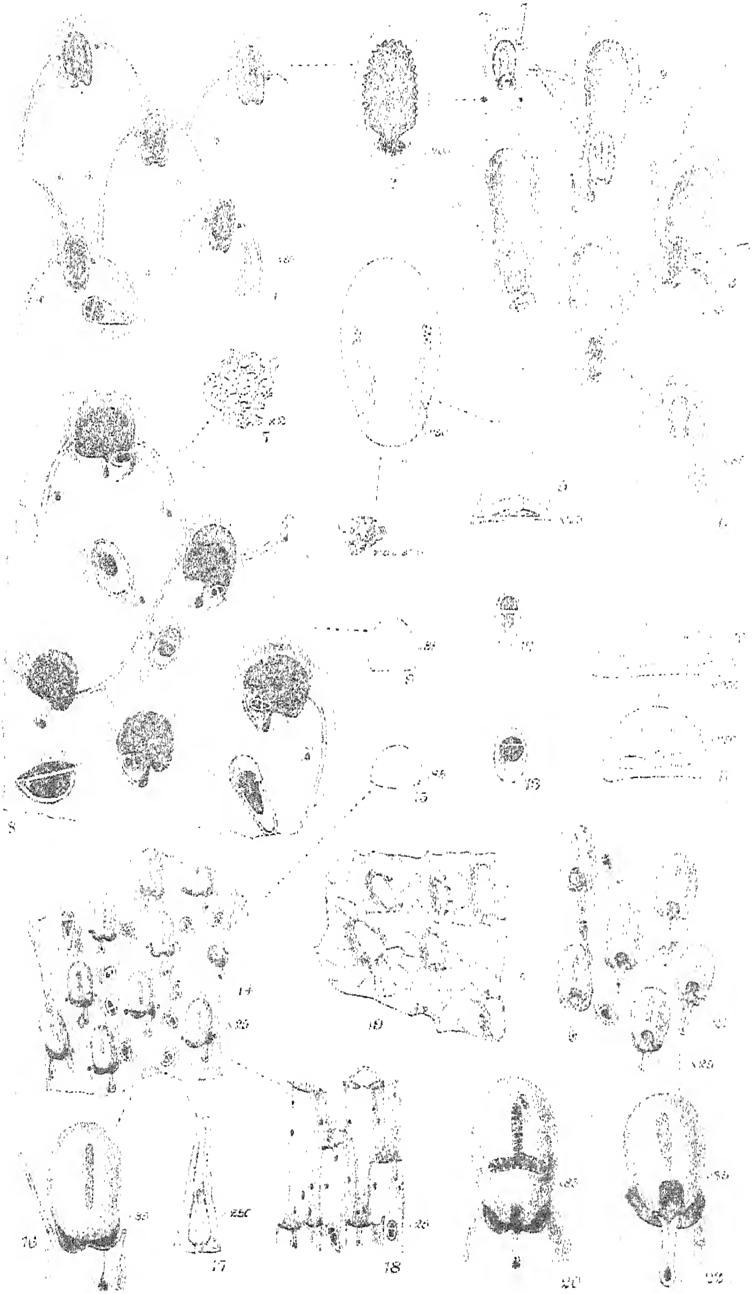
Figure 21 represents a calcined specimen from Tasmania, showing the way in which the groove of the sublabial pore forms two projections in the aperture. This can be seen in all the specimens which have come under my notice, though not in every zoœcium. The square opening in the lower part of the ovicell is also shown. The avicularium is sometimes erect like that of *R. cellulosa*, and there is a triangular fenestral avicularium.

RETEPORA NOVÆ ZELANDIÆ, sp. nov. (Pl. VI. figs. 1–6 & 19.)

The zoarium is convoluted and of a pink shade, but the colour has probably faded.

The zoœcia are distinctly separated, with the line of separation ending near the oral spines; surface minutely granular; no peristome; aperture in mature zoœcia sunk. Oral aperture very long, crenulated; sides nearly parallel, with a very large tooth on each side, giving the appearance of a sinus. The operculum becomes gradually narrower at the proximal edge and has the muscular dots very distinct, with a thickened band below each. At the side of the aperture, about halfway up, a spine articulated at the base; on the surface numerous pores as well as a few large scarcely raised triangular avicularia. The dorsal surface has fairly numerous vibices, usually meeting between the fenestræ, and in the area of some there is a triangular avicularium, but this is exceptional, whereas within the fenestræ, or on the side of the fenestræ, there are numerous triangular avicularia.

The specimens in my own collection which I first described are without ovicells, but Miss Jelly has very kindly lent me two slides from Wanganui (New Zealand) with ovicells which are widely open, somewhat like those of *R. Imperati*, and the terminal zoœcia have four to six spinous processes. One specimen has the triangular avicularium immediately below the aperture to almost every zoœcium. Although the operculum is Lepralioid the ovicell is Reteporidan, and besides there are the vibices and dorsal avicularia of this genus.



EXPLANATION OF THE PLATES.

Plate VI.

Fig. 1. *Retepora Solanderia*, Risso. × 25.
2. Do.; dorsal surface. × 25.
3, 4. Do. Natural size.
5. *Retepora Imperati*, Busk; ovicell. Porto Praya. × 25.
6. *Retepora tessellata*, Hincks; ovicell. × 25.
7. *Retepora tessellata*, var. *cæspitosa*, B.; young ovicell. × 25.
8. Do., do.; older ovicell from the same colony. × 25.
9. *Retepora elongata*, Smitt; ovicell. × 25.
10. Do.; younger ovicell from the same colony. × 25.
11. *Palmicellaria parallelata*, sp. n.; dorsal surface. × 12.
12. Do.; anterior surface. × 12. (*a*) mandible.
13. Do.; turned somewhat sideways to show the suboral rostrum.
14. *Retepora mediterranea*, Sm.; operculum. × 85.
15. Do.; dorsal surface. × 3.
16. Do.; oral aperture, showing small avicularium. × 85.
17. *Retepora cellulosa*, L. North Cape. × 25. (*a*) avicularium.
18. *Retepora Couchii*, var. *biaviculata*, var. nov. Rapallo. × 25.
19. *Palmicellaria parallelata*, sp. nov. × $2\frac{1}{2}$.
20. *Retepora cellulosa*, L.; North Cape; mandible. × 85.
21. *Retepora complanata*, sp. nov.; dorsal surface. × 5.
22. *Retepora Couchii*, var. *aporosa*, var. nov. × 25.

Plate VII.

Fig. 1. *Retepora novæ zelandiæ*, sp. nov.; without ovicells. × 85.
2. Do.; aperture after the operculum has been removed.
3. Do.; with ovicells. × 85.
4. Do.; operculum. × 250.
5. Do.; mandible. × 250.
6. Do.; young zoœcium. × 85.
7. *Retepora monilifera*, var. *munita*, MacG. × 2.
8. Do., do. × 85.
9. Do., do.; operculum. × 85.
10, 11. Do., do.; mandibles. × 250.
12. *Retepora cellulosa*, L.; avicularium.
13. *Retepora Beaniana*, King; avicularium.
14. *Retepora complanata*, sp. nov.; with ovicells. × 25.
15. Do.; operculum. × 85.
16. Do.; ovicell. × 85.
17. Do.; mandible. × 250.
18. Do.; without ovicells. × 25.
19. *Retepora novæ zelandiæ*, sp. nov.; dorsal surface. × 5.
20. *Retepora monilifera*, var. *munita*, MacG.; Victoria; ovicell. × 85.
21. *Retepora fissa*, MacG.; Tasmania. × 25.
22. Do.; ovicell. × 85.

On the Spinning-Glands in *Phrynus*; with an Account of the so-called "Penis" and of the Morphology of the Operculum. By H. M. Bernard, M.A. Cantab., F.L.S., F.Z.S.

[Read 20th December, 1894.]

(Plate VIII.)

A few months back my friend Mr. R. I. Pocock, of the British Museum, called my attention to the fact that, in tearing the cocoon of *Phrynus*, short threads were drawn out, which seemed to indicate the presence of spinning-glands; and he suggested that I should investigate the point. On clearing and mounting, the cocoon appeared to be a tough yellowish transparent membrane strengthened by threads which wound about it without any regularity, but which evidently formed the attachment of the cocoon to the under surface of the operculum. These threads varied greatly in thickness, being here uniformly thick, there uniformly thin, again elsewhere changing gradually from thick to thin.

Two young specimens at my disposal (unfortunately not well preserved) were cut into serial sections without, however, revealing any traces of spinning-glands. It seemed, therefore, highly probable that (as in the Chernetidæ) the spinning-glands in *Phrynus* are subject to periodic variations, *i. e.* develop only when required for the formation of the cocoon.

Light has, however, recently fallen upon the subject from an unexpected source. My attention was called (again by Mr. Pocock) to the so-called "penis" of *Phrynus*, which occurs presumably in the males. I had never seen this structure although I had examined a good many specimens of *Phrynus*. I had found it figured by Blanchard, who also calls it a penis. In order to facilitate the investigation, Mr. Pocock kindly allowed me to examine a specimen of *Tarantula tessellata*, Poc.*, belonging to the Natural History Museum, and also an excised "penis" which he had in his possession. As I was unable to dissect or section the specimens, the description can only be complete as far as it goes.

* Described and figured in "Arthropod Fauna of the West Indies," Journ. Linn. Soc., Zool. xxiv. p. 531.

The "penis" is a paired structure, the tips of its two limbs project backwards from beneath the genital operculum. The general character of these limbs can be gathered from the figures. They distinctly belong to the genital operculum, being outgrowths from its posterior wall, as shown in the diagrammatic longitudinal section (Pl. VIII. fig. 6). Anteriorly (or ventrally) they are attached almost immediately to the fold of the operculum, which has itself a distinct median suture. Posteriorly (or dorsally) the "penis" is attached far up to the opercular fold.

The genital aperture, opening on the posterior face of the operculum, is found in the channel formed by these limbs, so that the genital products can be conducted backwards to between the tips of the limbs, which tips are soft-skinned, somewhat spoon-like processes covered with fine hairs. The floor of the channel is continued to the posterior end of the limbs by a membrane joining the two longitudinally (*cf.* figs. 2–5). The structure so far seems to be an instrument for placing the genital products, *i. e.* either a penis for the placing of the spermatophores, or an ovipositor.

The study of these specimens further showed that this so-called "penis" functions not only as a genital organ, but also as a pair of spinning-mamillæ for the formation of the cocoon.

The secretion for the formation of the cocoons appears to exude on the anterior (ventral) side of the horizontal uniting membrane, from somewhere in the inner angles at the bases of the soft tips of the limbs. I was unable to find the exact apertures, but conclude that the secretion does exude from this spot from the fact that in the specimen examined a fragment of a membranous network made of clear, hard, thick irregular threads, with apparently open meshes, still remains tightly clutched by the "penis" (as shown in fig. 1). And further, among the torn and disorganized muscles of the excised "penis," a gelatinous mass, evidently one of the glands, persisted *in situ*, somewhat as shown in fig. 2. The gland belonging to the right side had been torn away in the process of excision.

The delicate tips of the organ, when not in use, are protected under the anterior edge of the sternite of the third abdominal segment (fig. 6). This figure [since confirmed by new sections] also illustrates the position of the spinning-gland.

Mr. Pocock believes * that the specimens with these structures are males, being characterized by features which in other Arachnids are known to belong to the male sex. If so, the organ would be primarily for the purpose of depositing the spermatophores. We should then be justified in concluding, from the presence of the glands in the "penis" (figs. 2–6), and from the fragment of a cocoon clutched by the same organ shown in fig. 1, that the male spins and drags about a cocoon. It is reported of the Chernetidæ that their males also, like the females, carry about eggs glued to the abdomen. The glands, however, which in the Chernetidæ yield the secretion belong, not to the first segment as in *Phrynus*, but to the second and third †. As a rule, that is in specimens without this penis, the cocoon is found attached under the genital fold, perhaps nipped by the pair of chitinous claw-like rods figured by Mr. Pocock *, certainly not by any such structure as that now under discussion. The glands, however, from which the substance exudes are probably in the same place in both forms, *i. e.* in forms with and without the penis.

Whether these organs deposit spermatophores or ova, *i. e.* whether they are male or female organs, can only be decided by dissecting a specimen so characterized, and ascertaining once for all the character of its sexual glands.

The biological problems connected with these structures must, however, yield in interest to the morphological. We note first two points:—(1) We have a pair of spinning-glands belonging to the first abdominal segment. (2) There can be little doubt that we have here a pair of rudimentary appendages not of the second (as Mr. Pocock suggests in a note), but of the first abdominal segment. These appendages apparently have been retained not only as a genital organ, but as a pair of nippers for dragging about the cocoon spun from the glands they contain.

With regard to the former of these, we note that Strubel ‡ describes for *Thelyphonus* a secretion exuding from the genital aperture, hardening in the air, and surrounding the eggs in the form of a thin-walled transparent sac. The glands yielding this

* "Pedipalpi of the Family Tarantulidæ," Ann. & Mag. N. H., Oct. 1894.

† *Cf.* "Notes on the Chernetidæ," Journ. Linn. Soc., Zool. xxiv. p. 410.

‡ "Development of the Pedipalpi," Zool. Anz. xv. pp. 87–93; Ann. & Mag. N. Hist. x. (1892) pp. 419–425.

secretion would be almost certainly homologous with a large pair of glands, one opening on each side of the genital aperture of *Galeodes*. In sections these glands are clearly seen to belong to the rudimentary limbs, which in this family compose the divided and primitive operculum. There seems to me little reason to doubt the homology between the spinning-glands of *Phrynus* and the glands of *Thelyphonus*, the secretion of which comes from the genital aperture, and of both with the glands opening in the genital aperture of *Galeodes*. We have, then, a pair of spinning-glands in the first abdominal segment of these three Arachnids opening on rudimentary limbs.

In certain Chernetidæ (*l. c. supra*) cement or spinning-glands occur on the second and third segments, on each side of the median line.

Lastly, in the Araneids, in addition to the principal spinning-mamillæ, median spinning-glands are found opening on each side of the median line on the fourth and fifth segments.

We have, then, here a remarkably complete series of spinning- or cement-glands, a pair on each of the first five abdominal segments. If we add to these the spinning-glands on the cheliceræ of the Chernetidæ and on the pedipalps of the mite *Tetranychus*, we have in all seven segments developing spinning-glands, in some cases two pairs.

This long series of glands, with all their variations of position and specialization, leads almost obviously to the conclusion that the common racial form of the Arachnids consisted of a number of similar, *i. e.* but slightly differentiated, segments, and could not have been an animal with a highly specialized segmentation, such as a *Limulus* or a Eurypterid.

Turning now to the second point, to the retention of the limbs of the first abdominal segment, not as mere opercular scales, but as well-developed appendages, two matters of interest arise.

The first is that the morphology of the genital operculum of the Pedipalpi receives an easy explanation. As is well known, it differs from that of other Arachnids in covering two segments. This fact was always difficult to explain on almost any hypothesis. Assuming the operculum to be a pair of rudimentary appendages of the first abdominal segment, folded backwards over the genital aperture, it was not easy to see how they came also to cover the stigmatic apertures which opened behind the rudi-

mentary appendages of the second segment. It seemed very improbable that the rudimentary appendages of the first segment had fused longitudinally with those of the second segment.

The actual method of fusing, it seems to me, is made quite clear by the specimen of *Tarantula*, the operculum of which is here drawn (Pl. VIII. fig. 1). The conditions there seen may be explained by assuming that the limbs of the first abdominal segment folded together backwards in the median line, as shown in the diagram (fig. 7); they thus passed between the rudimentary limbs of the second segment. The large plate of the present genital operculum is thus a composite structure. The anterior and median posterior portions belong to the appendages of the first segment; the lateral portions are the remains of the limbs of the second segment which have been folded back over the stigmatic apertures *.

The amount of fusion between the two pairs of rudimentary appendages composing the genital operculum is therefore not great. We only require the fold growing backwards from the (? first joints of the) first pair of limbs to fuse on each side of the median line with the inner edges of the limb-buds or prominences of the second pair. Anteriorly and laterally, both the rudiments were confluent with the abdominal surface.

In this way the difficult morphological problem presented by the genital operculum of the Pedipalpi is not hard to solve. It is clearly an acquirement within the Arachnidan phylum, and not, as Laurie claims, a primitive feature inherited from Eurypterine ancestors. In the first place, the evidence which Laurie † adduces in favour of the existence of a large operculum covering two segments in *Slimonia* is far from conclusive; and, in the second place, if it were, it would not necessarily bring the Eurypterids any nearer to the Arachnids. As Laurie appears to recognize, if such a genital operculum were a primitive feature of the Pedipalpi inherited from Eurypterine ancestors, it would imply that the Arachnids are not a natural group, inasmuch as the genital operculum in all the other important Arachnids is more primitive than it is in the Pedipalpi. Fortunately there

* I have briefly discussed this method of folding down in "Vestigial Stigmata in the Arachnida," Ann. & Mag. N. Hist. xiv. 1894, p. 149.

† "The Anatomy and Relations of the Eurypteridæ," Trans. Roy. Soc. Edinb. xxxvii. (2) 1893.

is no necessity to alter the classification in the way Laurie proposes.

The second point of interest with regard to this pair of appendages on the first abdominal segment lies in the evidence they yield us as to the original character of these limbs, which are now, as a rule, throughout Arachnids reduced to mere scale-like opercula, either fused in the middle line (*Chernetidæ*) or free (*Scorpio* and *Galeodes*). We have here certain witness that these limbs were once cylindrical appendages. The same conclusion can also be arrived at for *Thelyphonus*, the genital operculum of which is constructed on the same plan as that of *Phrynus*. In addition to these facts, we have the filamentous genital organs of the Phalangidæ very probably also to be deduced from limbs. When, further, on the second abdominal segment we have the (? three-jointed) pectines of *Scorpio*, and, still further, on the fourth and fifth segments the four-jointed mamillæ of certain Aviculariidæ, we have, it seems to me, fairly conclusive evidence that the abdominal appendages of the Arachnida, which have now so generally vanished, were jointed limbs like those of the thorax.

Whenever, therefore, among the vestiges of limbs on the abdomen we get anything more than a flat scale-like structure, it is not a leaf-like limb at all, but a typical filamentous and sometimes jointed appendage. We conclude, therefore, that the scale-like opercula (genital or stigmatic) of the Arachnida have no connection whatever with the leaf-like limbs of *Limulus*. The latter are most probably, it appears, persistent phyllopodan limbs*, while the former are the vanishing remains of jointed filamentous limbs.

Apart from all theories as to the origin of the Arachnida, the evidence to hand tends to show that the primitive form possessed a pair of jointed limbs with a pair of stigmata on every segment, thoracic and abdominal; and that, as above stated, there was very little differentiation among the segments. The specialization of the first six segments with their appendages for prehension and locomotion, and of all or of some of the remaining segments as a highly distensible vegetative sac, constricted off by

* *Cf.* Beecher, "Appendages of the Pygidium of *Triarthrus*," Amer. Journ. Sci. ser. 3, vol. xlvii. p. 298 (1894); and "The Systematic Position of the Trilobites," Quart. Journ. Geol. Soc., Aug. 1894.

a waist or diaphragm, accounts for the secondary degeneration of the limbs in this latter region.

From the operculum of *Thelyphonus* both the projecting limbs have now disappeared, as is also the case in many Phrynidæ. Their disappearance is, however, marked in the latter by the pair of rounded membranous eminences bearing the claw-like rods described and figured by Pocock, and perhaps also in the former by certain chitinous ridges visible on raising the operculum.

The fact that the "penis" is clutching what looks like the remains of a cocoon (fig. 1), and, from what we have seen, might quite as well be an ovipositor as a penis, inclines me to think that the occasional presence of these limbs may be reversionary, and not in any way indicative of sex. It is possible that we have here a case of dimorphism. Whereas a majority of the Phrynidæ, and, indeed, of Arachnida, have lost the distal portion of the genital limbs, they may occasionally reappear in the Phrynidæ, in which group perhaps, to judge from the character of the operculum, they persisted longer than in those Arachnids in which the opercula are now reduced to mere scales.

EXPLANATION OF PLATE VIII.

Fig. 1. Three anterior abdominal segments of *Tarantula tessellata*, Poc., ventral surface, showing the so-called "penis" tightly clutching a small fragment of a cocoon.

2. The ventral (morphologically anterior) view of the "penis," after removing the opercular fold, showing the mass of the (left) gland which secretes the material for the cocoon.

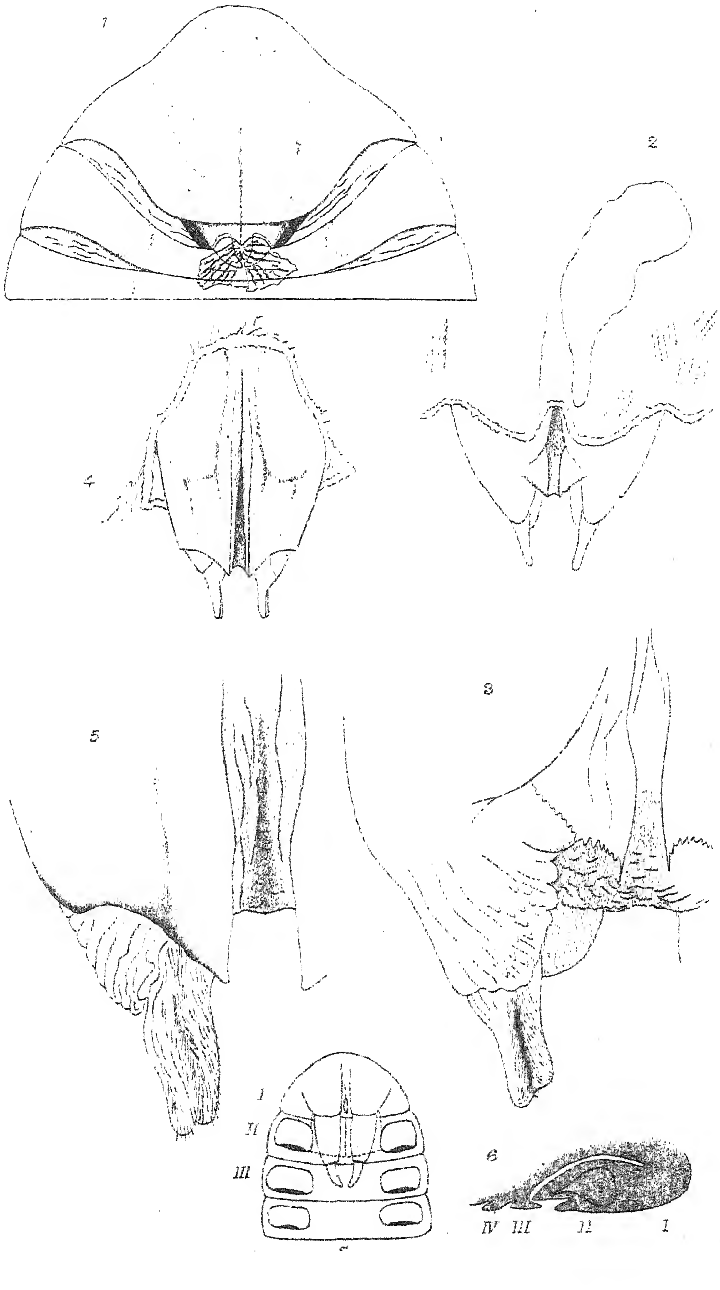
3. One tip of the same more highly magnified, showing the delicate tips of the organ. The gland opens somewhere among the folds at the inner base of these delicate tips.

4. Dorsal (morphologically posterior) view of the limbs forming the "penis;" deep down in the channel between them anteriorly is the genital aperture.

5. One tip of the same, more magnified.

6. Diagrammatic longitudinal section to illustrate the position of the "penis" when not used, and of the secreting-gland.

7. Diagram to show the relation of the limbs of the genital segment to those of the next following segments, to illustrate the probable origin of the large genital operculum of the Pedipalpi (*cf.* fig. 1).


1
2
4
5
3
6
I
II
III
IV

On the Insects other than Coleoptera obtained by Dr. Anderson's Collector during Mr. T. Bent's Expedition to the Hadramaut, South Arabia. By W. F. Kirby, F.L.S., F.E.S.

[Read 7th March, 1895.]

The insects to which the present paper relates, as well as the *Coleoptera*, *Arachnida*, and *Myriopoda* noticed in the succeeding papers, were presented to the British Museum (Nat. Hist.) by Dr. John Anderson, F.R.S., on condition that, after being worked out, a set of the duplicates should be forwarded to the Museum at Cairo. The *Coleoptera* have been dealt with by Mr. C. J. Gahan, and the remaining insects by myself. There were no *Lepidoptera* in the collection, and the *Neuroptera* and *Diptera* were represented only by a single species each. The *Arachnida* and *Myriopoda* have been worked out by Mr. R. I. Pocock.

A considerable number of specimens were obtained, but most of them belonged to three or four species only, and the total number of species in the collection (many of which were represented by a single specimen only) was very small. Many of the specimens, too, were bleached by spirit, which ought never to be used for collecting any insects except hard-shelled and smooth *Coleoptera, Hemiptera*, &c., which are not liable to be discoloured by it, and have no hair to be matted or delicate exposed wings to be torn.

Nevertheless, though most of the species were common and wide-ranging insects, there were a few interesting forms among them which were either new to, or badly represented in, the Museum Collection. One species I have ventured to describe as new to science; and two or three I am at present unable to determine with certainty, from want of sufficient material.

I will first give a complete list of the species in the Collection (amounting to about 20 in all) and will then discuss them in detail.

I should, perhaps, mention that, as usual in drawing up such small lists as the present, I use the names of the families only in the broadest sense.

ORTHOPTERA.

BLATTIDÆ.

Polyphaga syriaca, Sauss.

PHASMIDÆ.

Phasma ægyptiacum, Gray (?).

LOCUSTIDÆ.

Sphingonotus nebulosus, Fisch.
Schistocerca ægyptia, Linn.
S. peregrina, Oliv.
Euprepocnemis littoralis, Ramb.
Pœcilocera vittata, Klug.
Anepisceptus horridus, Burm.
(2 species of *Locustidæ* undetermined.)

NEUROPTERA.

TERMITIDÆ.

1 nymph, undetermined.

HYMENOPTERA.

CHRYSIDIDÆ.

Stilbum cyanurum, Forst.
Var. *amethystinum*, Fabr.

FORMICIDÆ.

Aphænogaster barbara, Linn.

SCOLIIDÆ.

Compsomeris vestita, Klug.

LEPIDOPTERA (unrepresented).

HEMIPTERA HETEROPTERA.

PENTATOMIDÆ.

Aspongopus viduatus, Fabr.

LYGÆIDÆ.

Lygæus militaris, Fabr.

REDUVIIDÆ.

Ectrichodia Andersoni, sp. n. See p. 284.
(3 undetermined species.)

NEPIDÆ.

Laccotrephes ruber, Linn.

DIPTERA.

ŒSTRIDÆ.

Cephalomyia maculata, Wiedem. (larva).

Order ORTHOPTERA.

Blattidæ.

Polyphaga syriaca, *Sauss.*

Polyphaga syriaca, *Saussure, Revue et Mag. de Zoologie,* (2) xvi. p. 346 (1864).

Heterogamia conspersa, *Brunner de Wattenwyl, Nouv. Syst. des Blattaires,* p. 358 (1865).

A single female specimen.

This species is recorded from Egypt and Syria.

Phasmidæ.

Phasma ægyptiacum, *Gray* (?).

Bacteria ægyptiaca, *Gray, Syn. Phasm.* p. 18 (1835).

Bacillus ægyptiacus, *Westw. Cat. Phasm.* p. 4 (1859).

A single damaged specimen, possibly belonging to this species.

I have shown (Proc. R. Dublin Soc. (2) vi. p. 569) that the true type of *Phasma,* Oliv., is *P. rossia,* Fabr.

Locustidæ.

Sphingonotus nebulosus, *Fisch.*

Œdipoda nebulosa, *Fisch. de Waldh. Ent. Ross.* iv. p. 290, pl. 27. fig. 1 (1846).

A single bleached specimen.

A species widely distributed in Central and Western Asia, extending from "Zungaria" to Asia Minor.

Schistocerca ægyptia, *Linn.*

Gryllus Locusta ægyptius, *Linn. Mus. Ulr.* p. 138 (1764).

A single specimen only.

A common species throughout the Mediterranean district, but not extending much farther.

Many authors call this species *Acrydium tataricum*; but it appears not to be the species thus named by Linné; while if it is generically distinct from *Schistocerca,* a new name will be required for the genus, for I have shown (Proc. R. Dublin Soc. vi. p. 592) that *Gryllus bipunctatus* and *subulatus,* L., are the true types of *Acrydium,* Geoffr.

Schistocerca peregrina, *Oliv.*

Acrydium peregrinum, *Oliv. Voy. Empire Ottoman,* ii. p. 424 (1807).

A single specimen only.

Common in North Africa, Syria, and occasionally in the extreme south of Europe.

Euprepocnemis littoralis, *Ramb.*

Gryllus littoralis, *Ramb. Faune de l'Andalusie,* p. 78, pl. vii. figs. 1, 2 (1838).

Three specimens of this species, which is recorded by Brunner von Wattenwyl from Spain, Rhodes, Beyrout, Cairo, and Kordofan. There is a large specimen in the British Mnseum from Quetta.

Pœcilocera vittata, *Klug* (?).

Dectisus vittatus, *Klug, Symbolæ Physicæ,* iii. pl. 25. figs. 6, 7 (1832).

A great number of specimens of the genus *Pœcilocera*, but all so much bleached or altered by spirit as to be almost unrecognizable. Several of the specimens, however, appear to belong to *P. vittata*, which Klug described from Dongola, and specimens of which are in the British Museum from Aden.

Anepisceptus horridus, *Burm.*

Hetrodes horridus, *Burm. Handb. Ent.* ii. p. 679, n. 2 (1839).

A small and rather pale-coloured male specimen, probably belonging to this species, which has a wide range in Syria, Arabia, and Egypt, but which was not previously represented in the Museum Collection.

Two more species of *Locustidæ* (one immature) which I am unable at present to determine.

NEUROPTERA.

Termitidæ.

A single nymph belonging to this family.

HYMENOPTERA.

Chrysididæ.

Stilbum cyanurum, *Forst.*

Chrysis cyanura, *Forst. Nov. Spec. Ins.* p. 89 (1771).

A very common and somewhat variable species, occurring in all the warmer parts of the Old World and in North America.

A single specimen was obtained of the following form:—

Chrysis amethystina, Fabr. Syst. Ent. p. 359, n. 12 (1775).

FORMICIDÆ.

MYRMICINÆ.

APHÆNOGASTER BARBARA, *Linn.*

Formica barbara, *Linn. Syst. Nat.* (ed. xii.) i. pt. 2, p. 962, n. 2 (1767).

A large number of winged specimens, among which were two males only, the rest being all females.

A common species in South Europe and North Africa.

SCOLIIDÆ.

COMPSOMERIS VESTITA, *Klug.*

Scolia vestita, *Klug, Symbolæ Physicæ,* iii. pl. 27. fig. 6 (1832).

Tiphia collaris, *Coqueb.* (an *Fabr.* ?) *Illustr. Ins.* ii. p. 54, pl. 13. fig. 3 (1801).

This is a common species in Spain, Northern Africa, and Arabia, and generally goes by the name of *collaris*, Fabr.; but as I doubt whether Coquebert has correctly identified the Fabrician species, I prefer to use a name about which there is no ambiguity.

Order HEMIPTERA.

Suborder HETEROPTERA.

PENTATOMIDÆ.

ASPONGOPUS VIDUATUS.

Cimex viduatus, *Fabr. Ent. Syst.* iv. p. 117, n. 145 (1794).

A common and variable Mediterranean, West Asiatic, and African species.

Four specimens were obtained, of which two belong to the following form:—

Pentatoma nigroviolacea, Beauv. Ins. Afr. Amér. p. 83, *Hém.* pl. 7. fig. 4 (1805).

The other two specimens have the hind border of the scutellum, the lateral borders of the scutellum, except the hinder lobe, the base of the tegmina and of the abdomen, and more or less of the principal nervures of the wings reddish. In one of these the tegmina and wings are mostly black; in the other the tegmina are slightly tinged with reddish towards the base, and the wings are yellowish hyaline with brown tips.

LYGÆIDÆ.

LYGÆUS MILITARIS, *Fabr.*

Cimex militaris, *Fabr. Syst. Ent.* p. 717, n. 103 (1775).

Four specimens, one immature.

A widely distributed species throughout the Mediterranean districts and the warmer parts of the Old World.

REDUVIIDÆ.

ECTRICHODIA ANDERSONI, sp. n.

Long. corp. 30 millim.

Female. Black, the upper surface of the thorax, the front angles and two spines on the scutellum, the base of the tegmina, and the inside of the front tibiæ rufo-testaceous. Thorax above divided into four lobes by a deep cross filled up with black, but the longitudinal groove not reaching to the extremity. Femora with two small teeth beneath, one on each side, before the extremity, preceded by one or two smaller ones on the medial line, smallest on the hind femora.

A single specimen, which has lost its tarsi and most of its antennæ. It is allied to *E. gigas*, Herr.-Schäff., from Africa, but the head and abdomen are entirely black, both above and below, and the legs almost so; and the thorax is much less coarsely punctured than in *E. gigas.*

I have named this new species after Dr. Anderson, to whom we are indebted for its discovery.

A single immature specimen of a black species apparently allied to *Pirates*, Burm., but with the tarsi only 2-jointed.

There are also one or two broken and immature specimens of *Reduviidæ*, not at present determinable, but apparently allied to *Conorhinus*, Lap.

NEPIDÆ.

LACCOTREPHES RUBER.

Nepa rubra, *Linn. Syst. Nat.* (ed. x.) i. p. 440, n. 2 (1758); *Mus. Ulr.* p. 185 (1764).

Nepa rubra, part., *Fabr. Mant. Ins.* ii. p. 277, n. 6 (1787); *Ent. Syst.* iv. p. 62, n. 6 (1794); *Syst. Rhyng.* p. 107, n. 6 (1803).

Nepa grossa, *Fabr. Syst. Rhyng.* p. 107, n. 5 (nec *Mant. Ins.* ii. p. 277, n. 5; nec *Ent. Syst.* iv. p. 62, n. 5).

A long series of this species, which is common all over Africa.

The Linnean description applies better to this than to the allied Asiatic species; and Fabricius correctly separated the latter (from China) in his 'Mantissa' and 'Ent. Syst.' by the shorter setæ, though he gives Tranquebar as the locality of *N. rubra*, and quotes a figure of Stoll's representing the Asiatic species. But in his 'Syst. Rhyng.' he gives *N. grossa* as an African species, and *alters the descriptions of both* grossa *and* rubra *to correspond*, thus reversing the names, in which Stål and other recent authors have carelessly followed him.

DIPTERA.

Œstridæ.

Cephalomyia maculata, *Wiedem.*

Œstrus maculatus, *Wiedem. Aussereur. zweifl. Ins.* ii. p. 256, n. 2 (1830).

A single larva of this species, which infests the camel.

Mr. E. Austen has kindly given me the name of the insect.

On the Coleoptera obtained by Dr. Anderson's Collector during Mr. T. Bent's Expedition to the Hadramaut, South Arabia. By C. J. Gahan, M.A., of the British Museum (Natural History). (Communicated by W. Percy Sladen, Sec. Linn. Soc.)

[Read 7th March, 1895.]

This small collection of Coleoptera includes little more than fifty species, and must represent but a very small proportion of the whole Coleopterous fauna of South Arabia. Of the species from the Hadramaut enumerated in the following list, some have already been recorded from the district of Yemen and other parts of Arabia; most of the remaining species are identical with, or closely allied to, forms occurring in Egypt, Nubia, and Abyssinia. A few have hitherto been known only from Persia and North-West India; while a few more have a range extending from Arabia to Senegal in West Africa. So far as the evidence, as a whole, of such a small collection can be of value, it seems to point to South Arabia as forming part of the Mediterranean subregion, with a slight admixture in its fauna of the Ethiopian element.

Carabidæ.

1. Pheropsophus africanus, *Dej.*, var.

In the four examples of this species which were taken in the Hadramaut the anterior border of the pronotum is black or dark brown in colour, and the basal margin is also more or less black; but beyond this slight difference in coloration I can find no characters by which to distinguish these examples from others from Barbary, Tunis, and Abyssinia with which I have compared them.

2. Anthia duodecimguttata, *Bon.*

3. Chlænius seminitidus, *Chaud.*

This species occurs also in Egypt and Abyssinia. It differs so little from *C. canariensis*, Dej., that I think these two should be regarded as varieties of the same species.

4. Crasodactylus punctatus, *Guér.*

Dytiscidæ.

5. Cybister tripunctatus, *Oliv.*

6. Cybister vulneratus, *Klug.*

7. Prodaticus pictus, *Sharp.*

This species has been founded on specimens from Persia and North India.

8. Hydaticus decorus, *Klug.*

9. Hydaticus histrio, *Clark.*

Five or six examples taken in the Hadramaut appear to be referable to this species, which its author described from North Indian specimens. *Hydaticus rectangulus*, Sharp, which is recorded from Persia and North India, is probably the same species. The Arabian examples show variations from forms in which the inner testaceous band of each elytron is reduced to a transverse patch at the base, to others in which it is a complete, though rather narrow, band closely accompanying the inner row of punctures.

10. Eretes helvolus, *Klug.*

11. Eretes succinctus, *Klug.*

The preceding two forms are considered by Dr. Sharp to be merely colour varieties of the very widely distributed *Eretes sticticus*, Linn.

Gyrinidæ.

12. Dineutes æreus, *Klug?*

Four examples taken in the Hadramaut exhibit a slight difference in the form of the elytra from Egyptian and other African specimens with which they have been compared.

Hydrophilidæ.

13. Hydrous senegalensis, *Perch.*

14. Temnopterus spinipennis, *Gory.*

15. Sternolophus solieri, *Casteln.*

Scarabæidæ.

16. Scarabæus isidis, *Casteln.*

17. Heliocopris gigas, *Linn.*

18. Catharsius inermis, *Casteln.*

19. Cheironitis orsidis, *Reiche.*

20. Onitis alexis, *Klug.*

21. Oryctes boas, *Fab.*

22. Oryctes rhinoceros, *Linn.*

23. Cetonia (Pachnoda) histrio, *Fab.*

Buprestidæ.

24. Psiloptera arabica, sp. n.

Oblongo-ovata, cuprascens; capite irregulariter fortiterque et subrugoso punctato; prothorace a medio antice sat distincte angustato, supra medio fortiter sat dense punctato, versus latera densius subrugosoque punctato, margine basali utrinque sinuata; elytris punctato-striatis, intervallis paullo elevatis, subcostatis, costis sparse punctatis; apicibus oblique truncatis, angulo suturali acuto, angulo exteriore denticulato; processu prosterni bisulcato, sulcis minute setigeroso-punctatis, intervallo medio et lateribus costiformis, impunctatis; pectore pedibusque fortiter sat dense punctatis; abdomine foveolatim punctato, segmento primo medio sulcato, punctis foveolisque setigeris; vitta abdominis utrinque violacea, griseo-pubescente. Long. 15–16 mm.

This species somewhat resembles *S. rugosa*, Beauv., of which it has nearly the same shape, the elytra being, however, more obliquely truncate at the apex. The sculpturing of the head, thorax, and underside is very similar in the two species, but that of the elytra differs pretty considerably. In the present species

the striæ of the elytra are deeper, with the intervals raised, convex, and somewhat costate in appearance; the outermost costa, which begins only after about the anterior fourth, is from this point distinct up to the apex; two or three of the costæ nearer the suture are also tolerably distinct throughout the greater part of their course, being interrupted by punctures only at remote intervals; the intermediate costæ are more frequently interrupted by punctures, especially near the base, where the elytra present a somewhat irregularly rugose appearance.

TENEBRIONIDÆ.

25. ZOPHOSIS, sp.

HISTEROMIMUS, gen. nov. (*Erodiidarum*).

Mentum transversum, antice truncatum. Mandibulæ prominentes, intus ad marginem inferiorem bidentatæ, supra ante medium oblique leviterque carinatæ. Labrum fere occultum, apice pilosum. Clypeus medio paullo productus, et antice tridentatus. Oculi sat parvi, laterales, occulti. Prosternum medio elevatum, et antice paullo productum.

This genus is allied to, and rather closely resembles, *Histeromorphus*, Kraatz; but the prothorax is much more strongly convex above; the clypeus is less produced in front, and is tridentate at the anterior margin; the prosternum is somewhat raised along the middle, and is slightly produced in front, so that the anterior margin of the prosternum is bisinuate, instead of being simply arcuate; the eyes are less elongated than those of *Histeromorphus*, and resemble those of *Spyrathus*.

26. HISTEROMIMUS ARABICUS, sp. n.

Niger, nitidus; capite antice densius fortiusque punctulato, supra minus dense minutiusque punctulato; prothorace amplo, dorso valde convexo, sparse minutissime punctulato, lateribus a basi ad medium paullo divergentibus, deinde rotundato-convergentibus, angulis antero-lateralibus subobtusis; elytris subnitidis, haud punctatis, vage undulatim rugosulis; prosterno rugoso-punctato; meso- metasternoque et abdominis processu intercoxali subrugosis; abdomine nitido, sparse punctato. Long. 9, lat. 6 mm.

This species much resembles *Histeromorphus plicatus*, Kraatz, of which it has nearly the same outline, but may be easily distinguished by the more convex pronotum, the tridentate anterior clypeal margin, and other characters mentioned in the generic diagnosis.

27. Tentyria orbiculata, *Fab.*, var. glabra, *Sol.*?

Under this name Baudi (Deutsche ent. Zeit. xxv. p. 276) has referred to some Arabian examples and has pointed out how they differ from Egyptian specimens. The examples collected in the Hadramaut appear to be identical with the forms noted by Baudi.

28. Tentyria sp.

29. Mesostena puncticollis, *Sol.*

30. Oxycara sp.

31. Oxycara sp.

32. Adesmia lacunosa, *Klug.*

33. Adesmia cancellata, *Klug*, var.

This variety is distinguished by having the prothorax very finely and very sparsely punctured, nitid, and impressed along the middle, from the base to near the apex, by a rather fine groove. In the form and sculpture of the elytra the variety completely agrees with the ordinary form.

34. Adesmia interrupta, *Klug.*

35. Adesmia tuberculifera, sp. n.

Oblongo-ovata, nigra, nitida; pronoto medio sparse minuteque punctato, versus latera densius fortiusque punctato; elytris fere totis crebre fortiterque tuberculatis, tuberculis suboblongis, fere regulariter dispositis, tuberculis per angulum inter dorsum subplanatum et latus deflexum paullo angustioribus, costæ simulantibus, latere deflexo ipso paullo convexo, sine costa. Long. 16–20 mm.

To this species I refer a number of examples which are characterized by having the elytra densely studded with rather large and somewhat oblong tubercles; the disk of the elytra flattened or slightly convex; the deflexed sides also slightly convex, devoid of a costa, and, throughout the greater part of their extent, almost as thickly and strongly tubercled as the disk. Along the angle formed by the deflexed side with the disk the tubercles are somewhat narrower and give rise to the appearance of a costa. The pronotum is without a median impression, is very finely and sparsely punctured in the middle, more thickly and strongly towards each side, where it is marked off from the flank of the prothorax by a very fine but distinct carina. The male is narrower than the female, its elytra are scarcely dilated towards the middle, and the angle formed by each of the deflexed sides with the disk is sharper and more distinct

The species, which is nearly allied to *A. acervata*, Klug, may be distinguished from it by the larger size and the thicker and more equal distribution of the tubercles on the elytra. *A. austera*, Baudi, with the type of which Dr. Gestro has very kindly compared examples, is also a closely allied species, but has smaller and less thickly placed tubercles on the elytra, and the angle between the disk and deflexed side of each elytron is less pronounced.

36. Adesmia assimilis, sp. n.

Oblongo-ovata; prothorace transverso, sparsim sat minute punctato, nitido, dorso medio lineato-sulcato; elytris usque ad medium paullo ampliatis (♀) vel vix ampliatis (♂), dorso sat dense tuberculato, a latere deflexo costa crenulata separato; lateribus utrisque in dimidio postico costa crenulata instructis. Long. 17–24 mm.

This species has much resemblance to the preceding one, but the tubercles of the elytra are not so thickly nor so regularly placed, and are rather smaller in size; the disk of the elytra is limited on each side by a crenulate costa, nearly parallel to which, on the posterior half or two-thirds of the deflexed side, is a somewhat feebler crenulate costa. The slightly concave area on each side between these two costæ is tubercled less strongly than the disk, the area below it is feebly rugose and vaguely punctured. The pronotum is sparsely and minutely punctured, and is impressed along the middle by a rather faint groove which does not reach quite to the anterior margin.

37. Himatismus villosus, *Haag.*

38. Prionotheca coronata, *Oliv.*

39. Ocnera persea, *Baudi.*

40. Ocnera hispida, *Forsk.*

41. Thriptera crinita, *Klug.*

42. Pimelia arabica, *Klug.*

43. Pimelia sp.

44. Vieta sp.

Curculionidæ.

45. Brachycerus sp.

46. Cleonus hieroglyphicus, *Oliv.*

47. Cleonus dealbatus, *Germ.*

CERAMBYCIDÆ.

48. PLOCÆDERUS MELANCHOLICUS, *Gahan*, var.

This variety occurs also in Somali-land. It differs from the typical West-African form in the darker coloration of the elytra, which are almost black, and in having the third joint of the antennæ armed with a short spine or tooth at the inner distal angle. The variety very much resembles *P. denticornis*, Fab.; but in the latter the third antennal joint has a rather long, sharp, and very distinct spine at the inner distal angle, and the succeeding joints of the antennæ are also much more distinctly spined than in the present variety.

49. COPTOPS FUSCA, *Oliv.*

HALTICIDÆ.

50. POLYCLADA BENTI, sp. n.

Capite testaceo; antennis pectinatis, nigris, articulo primo testaceo; prothorace flavo-testaceo, supra maculis sex nigris–duabus antice, quatuor in serie arcuata ad basin; elytris dense punctatis, nigris, utrisque maculis septem flavo-testaceis; corpore subtus testaceo, metapleuris, femorum apicibus, tibiis tarsisque nigris. Long. 11 mm.

Head almost entirely reddish testaceous in colour; somewhat finely and closely aciculate-punctate above. Prothorax pale testaceous, marked above with six black spots, of which two are close to the anterior margin, while the remaining four are arranged in an arcuately transverse series close alongside the basal margin. Elytra black, thickly punctured; each with seven pale yellowish testaceous spots, one at the base close to the scutellum, one below and behind the shoulder, two placed transversely at the middle, two between the middle and apex, also placed transversely and united by a narrow tract; the seventh, somewhat more rounded, placed close up to the apex, from which it is separated only by a very narrow black border; epipleure of each elytron pale testaceous except along the apical margin. Body underneath testaceous, with the sides of the breast blackish; tibiæ, tarsi, and the apices of the femora also black. Antennæ of the male almost as strongly pectinated as in *P. pectinicornis*, Oliv., black, with the first joint testaceous.

On the Arachnida and Myriopoda obtained by Dr. Anderson's collector during Mr. T. Bent's Expedition to the Hadramaut, South Arabia; with a Supplement upon the Scorpions obtained by Dr. Anderson in Egypt and the Eastern Soudan. By R. I. Pocock, of the British Museum (Natural History). (Communicated by W. Percy Sladen, Sec. Linn. Soc.)

[Read 7th March, 1895.]

(Plate IX.)

ARACHNIDA.

Scorpiones.

Prionurus crassicauda, *Oliv.*

Loc. Hadramaut Valley. Three specimens.

Specimens agreeing with the typical form, but certainly paler in colour, the trunk approaching ferruginous, and contrasting rather strongly with the pale yellow of the legs and chelæ. Specimens sent by Dr. Jayakar from Muscat are much darker brown, the same tint prevailing upon the legs and chelæ (*cf. infra*, p. 307).

Buthus quinquestriatus, *Hempr. & Ehrenb.*

Loc. Hadramaut. Collected by the way.

Buthus acute-carinatus, *Simon.*

Buthus acute-carinatus, *Simon, Ann. Mus. Genova,* xviii. p. 245, pl. viii. fig. 18 (1883).

Loc. Hadramaut Valley. One young specimen.

Recorded originally from Tes (Taez) in Arabia. The British Museum has recently received a large number of examples from Aden, a few from Perim Island, and a few more from Zaila in Somali-land near the Red Sea coast. The largest examples measure about 45 mm. in length. It appears to be a well-marked little species, as Simon's figure and description abundantly prove; yet Prof. Kraepelin regarded it as synonymous with *B. dimidiatus.* But this opinion is absolutely untenable, seeing that the two forms exist side by side in the same place without in any sense blending. In addition to the distinctive characters touching granulation, development of keels, proximity of eyes, colour, &c., which M. Simon pointed out, it may be added that in *B. acute-carinatus* there are only twelve rows of teeth along the movable digit of the chelæ, and that the isolated teeth of the

inner row are situated much further forwards than in *B. dimidiatus.* (Compare also Thorell, Bull. Soc. Ent. Ital. xxv. p. 364, 1894.)

BUTHUS DIMIDIATUS, *Simon.*

Buthus dimidiatus, *Simon, Ann. Mus. Genova,* xviii. p. 244, pl. viii. fig. 17 (1883).

Loc. Hadramaut.

This species was originally recorded from Tes (Taez) in Arabia. The British Museum also has examples from Perim Island (*J. J. Walker and E. W. Oates*). The examples from this island which were obtained by Mr. Walker were formerly identified by me (Ann. & Mag. Nat. Hist. (6) viii. p. 241) as *B. scaber* (Hempr. & Ehrenb.); and I am still of opinion that the reference may in the end prove to be correct. But since the figure of Ehrenberg's type specimen does not quite suit the Perim examples, inasmuch as the trunk is represented as pale and not olivaceous, I consider it advisable, until genuine specimens of *B. scaber* from Arkiko come to hand, to look upon the latter provisionally as a distinct species.

The name *dimidiatus* which I formerly doubtfully applied to the Perim specimens I now think is unquestionably the right title for them; for the characters in which *dimidiatus* appeared to differ from the Perim examples—namely, in the granulation of the vesicle and the parallelism of the sides of the tail—I now discover are characteristic of half-grown specimens, but are more or less obliterated in the adult. Full-grown specimens of this species attain a length of about 75 mm.; they then present the colouring described by Simon for his examples, and have the anterior segments of the tail very wide, much wider than the posterior, with strongly convex sides, the width of the first being about equal to the length of the third and much greater than its own length. But in two young examples from the Hadramaut Valley measuring about 35–38 mm., the tail is much more parallel-sided, the anterior segment is not noticeably convex at the sides and is only as wide as long, and the granulation of the lower surface of the vesicle is much coarser than in the adult. They thus closely agree with Simon's example, which measured 49 mm. But they present the further interesting difference in having the whole of the trunk pale, except the anterior part of the carapace, which is blackish green; and the hands and digits, instead of being pale, are also blackish green.

The two adult examples from Hadramaut agree in colouring exactly with Simon's *dimidiatus*; but the three examples from Perim that I have seen differ in having the crests on the legs and palpi, and also the hands in part, blackish.

BUTHUS ANTHRACINUS, sp. n. (Pl. IX. figs. 1, 1 *a*.)

Colour of the upper side of the trunk and of the entire tail blackish green, like that of *Orthochirus melanurus* and *Prionurus bicolor*; legs of the 1st pair yellow, the remaining pairs with the three distal segments yellow, the rest strongly or only slightly infuscate; mandibles infuscate distally; chelæ mostly pale yellow, but slightly infuscate at the junction of the hand and digits, the crests also on the humerus and brachium sometimes rather strongly infuscate; lower surface of cephalothorax and abdomen pale or ferruginous.

Trunk rather coarsely granular above; the keels on the *carapace* not strongly defined, the anterior ones breaking up into granules long before reaching the front border; the ocular tubercle smooth; the eyes rather widely separated; the intermediate and posterior median keels forming an irregular granular crest; carapace a little longer than the 1st caudal segment, + half the 2nd.

Terga coarsely granular in the posterior half, nearly smooth between the keels; the three keels distinct, but short; the lateral ones not apparent upon the 1st and 2nd terga; the crests on the 7th well developed, forming almost a complete loop.

Sterna smooth, with finely denticulate posterior border; the last with four smooth conspicuous keels.

Tail about five times as long as the carapace, robust, but with the 1st segment wider than the 5th; all the normal keels well developed and finely granular, the inferior ones, however, on the 1st nearly smooth; the median lateral well developed on the 2nd and 3rd segments, and visible on the 4th, the intercarinal spaces granular; upper surface of tail smooth, rather strongly excavated, upper angles of 5th not sharp; *vesicle* large, globular, angled beneath the aculeus, coarsely punctured.

Chelæ smooth; crests on humerus granular, on brachium smooth, but well developed; none on manus, which is a little wider than the brachium; hand-back nearly two-thirds the length of the movable digit, which is furnished with about 9 median rows of teeth, the large teeth of the internal series nearly opposite the middle of the space that separates those of the external series.

Legs with granular crests on the femora, smooth on the patellæ; the posterior two feet on each side clothed below with two rows of setæ, the anterior of these rows atrophied on the anterior feet; coxæ of the legs granular, especially on the edges.

Pectines furnished with from 17–22 teeth.

Measurements in mm. of type.—Total length 36·5, of carapace 4·4, of tail 22·5; width of 1st segment 3·3, of 5th 2·9.

Loc. Hadramaut. 5 specimens collected "by the way."

This species seems to be rather variable in its characters. Those respecting colour have been already mentioned; but in addition the smallest example obtained has the interocular area of the carapace smooth, and the coxæ also almost smooth. The sculpturing of the posterior segments of the tail appears in some cases to be describable as wrinkled.

There is no doubt that this species approaches the genus *Butheolus*; and of the forms ascribed to this genus, it is to the type *thalassinus*, Sim. (Ann. Mus. Genov. xviii. p. 248), described from Aden, that the resemblance is greatest. *Butheolus thalassinus* is unknown to me; but, judging from Simon's description, it may be distinguished from *Buthus anthracinus* by having the anterior region of the carapace sloped, the ocular tubercle granular, the 5th abdominal sternum coarsely granular, the tail posteriorly dilated (compare, however, the figure, which represents the tail as posteriorly narrowed), and the vesicle small and narrow. In all these characters *thalassinus* approaches the best known form of all, the allied *Orthochirus melanurus* (Kessler) = *Schneideri* (L. Koch)*.

PARABUTHUS LIOSOMA (*Hempr. & Ehrenb.*).

Loc. Shehu, and by the way.

NEBO FLAVIPES, *Simon*.

Nebo flavipes, *Simon, Ann. Mus. Genova*, xviii. p. 249 (1883).

Loc. Hadramaut. Four specimens, collected by the way.

The largest of these Scorpions is a male measuring 123 mm.; this size is chiefly owing to the great length of the tail, which is almost six times as long as the carapace. The British Museum, however, has an example still larger than this one, namely, a

* It will probably be found that more than one species has been included under this name; but more material must be obtained before their limits can be accurately determined. Prof. Kraepelin's figure of the dentition of the chela on pl. ii. fig. 21 of his paper is quite unlike the arrangement in some of the specimens that I have examined.

specimen from the Isthmus, Aden, obtained by Mr. E. W. Oates, which measures 144 mm. in length. The specimens described by Simon from Aden were females. Dr. Jayakar has also sent us the species from Muscat.

PEDIPALPI.

PHRYNICHUS JAYAKARI, *Poc.*

Phrynichus jayakari, *Poc. Ann. & Mag. Nat. Hist.* (6) xiv. p. 294, pl. viii. fig. 3 (1894).

Loc. Hadramaut.

This species was described from two examples sent to the British Museum from Muscat by Dr. A. G. Jayakar. The specimen from the Hadramaut merely differs from the types in being a little paler-coloured, the cephalic area being blotched with ferruginous patches instead of being ferruginous all over.

Prof. Kraepelin (Abh. nat. Ver. Hamburg, xiii. 1895) has recently, in his characteristically sweeping manner, disposed of all the difficulties which beset the determination of the nearly allied species of this genus, by setting them all down as synonyms of each other. I would, however, warn those who work at this group, that I am not acquainted with a particle of evidence that the species named *Jayakari*, *Phipsoni*, and *pusillus* are the same. They are, on the contrary, perfectly distinct. I think, however, that it is highly possible that *Jayakari* will prove to be the same as *Deflersi* of Simon, described from Obock.

ARANEÆ (Spiders).

Only five species of this order were obtained :—

FILISTATA TESTACEA, *Latr.*
Loc. Hadramaut.

PEUCETIA ARABICA, *Simon.*
Loc. Hadramaut.

SPARASSUS WALCKENAERII, *Sav.*
Loc. Hadramaut.

SELENOPS ÆGYPTIACUS, *Sav.*
Loc. Hadramaut.

LATHRODECTUS 13-GUTTATUS, *Rossi.*
Loc. Hadramaut.

MYRIOPODA.

CHILOPODA.

Family SCOLOPENDRIDÆ.

SCOLOPENDRA TRUNCATICEPS, *Poc.*

Scolopendra truncaticeps, *Poc. Trans. Linn. Soc.*, 2nd ser. *Zool.* v. pt. 3, p. 119.

Loc. Shehu.

SCOLOPENDRA VALIDA, *Luc.*

Scolopendra valida, *Lucas in Webb & Berthelot's Hist. nat. des Iles Canaries*, ii. *Entomol.* p. 49, pl. vii. fig. 15 (1836–44); *Newport, Tr. Linn. Soc.* xix. p. 402 (1845).

In Ann. & Mag. Nat. Hist. May 1888, pp. 335–338, I pointed out the occurrence of *Scolopendra valida*, a Canary Island species, in Socotra and Bushire. The British Museum has subsequently received examples from S. Arabia, and I think the following subspecies may be recognized.

Subspecies DESERTICOLA, nov.

Head, antennæ, first tergite, and maxillipedes deep green; trunk olivaceo-castaneous, with the posterior border of the terga banded with green. Legs entirely flavous.

Loc. Shehu. A single specimen, measuring 125 mm. in length.

The Museum has received specimens of the same subspecies from Aden (*S. R. Shopland*) and Muscat (*A. G. Jayakar*). It seems to extend, therefore, over the whole of S. Arabia.

On the other side of the Persian Gulf, *i. e.* at Bushire and Jask, there appears to be another type of this Centipede, which may be called *Scolopendra valida* subspecies *persica*, nov., and be diagnosed as follows:—Head and antennæ deep green; distal ends of the anal legs also deep green; terga flavous (Bushire; 3 examples, 113 mm.). Two examples from Jask, 118 mm. in length, resemble those from Bushire, but four others have the anal legs quite green and some of the anterior terga bordered with green. Specimens of this subspecies from Jask have been received from Mr. B. T. Ffinch and Mr. Butcher.

A third subspecies may be recognized as *S. valida* subsp. *Balfouri*, nov. The young are entirely pale, but in adult specimens, which may reach a length of 190 mm., the head, antennæ, and all the legs are green, or even black, and although the posterior half of the trunk is paler, the anterior half is distinctly olivaceous or olivaceo-castaneous.

The typical form from the Canary Islands appears to be of a uniform olivaceous colouring, and to offers none of the strongly contrasting patterns characteristic of the subspecies inhabiting Persia, Arabia, and Socotra. Examples of the subspecies *Balfouri* were evidently referred to by Karsch as *Collaria morsitans* (Abh. nat. Ver. Bremen, ix. p. 67, 1884).

DIPLOPODA.

SPIROSTREPTUS ARABS, sp. n.

♀. *Colour.* Legs and antennæ clear reddish yellow; head infuscate above, fading off into ferruginous below; segments deep black; the lateral portions of the 1st tergite obscurely ferruginous; the anterior half of the segments ferruginous or ochraceous.

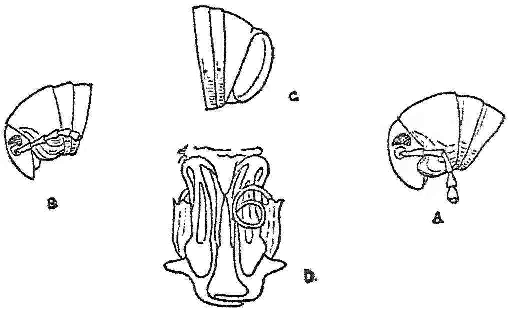
Head. Frontal region slightly sculptured, without a definite striate ridge beneath the edge of the 1st tergite; frontal sulcus deep; faint trace of a stria between the inner angles of the eyes; a small pit-like depression on the inner side of antennal socket; lower half of head strongly wrinkled, sculptured with anastomosing striæ and sulci; labral border with a deep, unidentate, angular excision. Distance between eyes about equal to their long diameter; eyes composed of about 7 transverse rows of ocelli. Antennæ extending laterally to the end of the 3rd segment; segments 2–6 gradually decreasing in length.

1*st tergite* minutely punctulate above, its lateral portion extending below the lower border of the 2nd; its posterior border emarginate above the posterior angle, which is rounded; the anterior border much more deeply and widely emarginate above the angle, which is convexly rounded; the lower portion of the segment covered with cristules as shown in the figure (p. 299). The rest of the terga minutely punctulate; the transverse sulcus complete on all from the 2nd backwards, lying in a shallow depression; the area in front of it closely covered with transverse cristules, which behind become stronger and more widely separated from each other; the area behind the sulcus longitudinally striate up to the pore. *Pores* minute, beginning on the 6th segment some distance behind the sulcus, which is lightly sinuate opposite to them.

Sterna quite smooth; grooves short. *Anal tergite* with a very short triangular process in the middle of its hinder border, a shallow transverse depression in front of it. *Valves* with strongly

compressed margins, their apex not covered by the caudal process; *sternum* triangular.

Legs with a double row of setæ on the lower surface of the patella, tibia, and tarsus, these spiniform on the tarsus, a single row of setæ on the other segments; coxa and trochanter hairy above at the distal end; the upper side of these two segments distinctly carinate.



Spirostreptus arabs.
A. Head of ♂. B. Head of ♀. C. Tail of ♂. D. Anterior aspect of copulatory apparatus.

Number of segments, 66. Length about 140 mm.

♂. Thinner than ♀; the lower half of the head smoother; lateral portion of the 1st tergite more strongly produced, *cf.* fig. In the anterior half of the body the patellæ and tibiæ of the legs distinctly padded distally, the pads becoming less and less distinct towards the anal end of the body. Copulatory foot as in figure.

Loc. Hadramaut. A large number of specimens.

Supplementary Note upon the Scorpions obtained in Egypt and the Soudan by Dr. John Anderson, F.R.S.

Buthus europæus (*Linn.*).

Loc. Mersa Matroo, Ramleh, Duroor.

Buthus quinquestriatus (*Hempr. & Ehrenb.*).

Androctonus (Leiurus) quinquestriatus (*Hempr. & Ehrenb.*), *Verh. nat. Fr. Berlin*, i. p. 353 (1829); *iid. Symb. Phys., Scorp.* pl. i. fig. 5; and of all authors.

A large number of examples from the following localities:—Suez, Ras Gharib, Amarna, Fayum, Abbasiyeh, and Assouan.

Buthus leptochelys (*Hempr. & Ehrenb.*).

Androctonus (Leiurus) leptochelys, *Hempr. & Ehrenb., Verh. nat. Freunde Berlin*, i. p. 355 (1829); *Symb. Phys., Scorpiones*, no. 3.

Androctonus macrocentrus, *iid. op. cit.* p. 355; *Symb. Phys., Scorp.* pl. i. fig. 6.

Androctonus thebanus, *iid. op. cit.* p. 358; *Symb. Phys., Scorp.* pl. i. fig. 4.

Buthus arenicola, *Simon, Expl. Sci. de la Tunisie, Arachnides,* p. 51 (1885).

Loc. Duroor, 60 miles north of Suakin; S.W. Bank of Suez Canal (4 specimens).

I have compared examples of *B. arenicola* from Biskra with the Egyptian forms of *B. leptochelys*, and I feel sure that the two are identical.

BUTHUS ACUTE-CARINATUS, *Simon.*

Buthus acute-carinatus, *Simon, Ann. Mus. Genova,* xviii. p. 245, pl. viii. fig. 18 (1883); also *Thorell, Bull. Soc. Ent. Ital.* xxv. pt. 4, p. 360 (1894).

Loc. Duroor, 60 miles north of Suakin.

From this locality four ♀ specimens were obtained, the length of the largest being about 36 mm. In these the anterior edge of the carapace and the keels on the carapace and terga are infuscate, as well as the anterior two-thirds of the 5th caudal segment and the inferior keels of the 4th. Moreover the crests on the legs and palpi are for the most part lightly infuscate. In this particular these Duroor examples differ markedly from three ♀ specimens obtained at Thebes by Mr. Carter, which are a clear lemon-yellow throughout, the three ocular clusters being alone of a dense black. All the other examples of this species in the British Museum, namely 2 from Perim Island, 2 from Zaila in Somaliland, and 8 from Aden, agree substantially with those mentioned above from Duroor. It is worth mentioning, however, perhaps that two young examples (about 20 mm.) from Aden have the trunk and appendages rather deeply infuscate, and the black ring on the anterior half of the 5th caudal segment very deep and sharply defined.

[I here subjoin the descriptions of two species of Scorpions, closely allied to *Buthus dimidiatus*, which have been recently sent to the British Museum.

BUTHUS JAYAKARI, sp. n. (Pl. IX. figs. 2, 2 *a*.)

Colour. Anterior half of carapace greenish black, the rest of the trunk, with the exception of the keels and granules which are blackish, pale; the first two segments of the tail pale above and below, the keels only being blackish, the 3rd segment becoming infuscate, the 4th, 5th, and vesicle entirely blackish

green; legs and lower surface of the trunk quite pale, the palpi with the coxa, trochanter, and femur pale, the tibia, manus, and digits (except the tips) strongly infuscate.

Carapace resembling that of *dimidiatus*, except that the interior median crests are represented by two distinct oblique rows of granules, the posterior of which is not continuous with the posterior median crest.

The *tergites* resemble those of *dimidiatus*. The tail is like that of *dimidiatus* in the development of its keels, the median lateral crest being imperceptible on the 4th and almost absent on the 3rd segment; but the tail differs very noticeably in the thickness of its anterior segments, these being normal in *Jayakari* and not so thickened as in *dimidiatus*; consequently the tail appears to be more parallel-sided. The difference in the narrowness of the 1st segment may be estimated by the fact that in *dimidiatus* its width is equal to the length of the 3rd segment, whereas in *Jayakari* it is very much less (*cf.* measurements).

Sterna like those of *dimidiatus*, the external of the four keels on the 5th being either about half the length of the internal or about two-thirds.

Chelæ like those of *dimidiatus* but more thickly hairy, and with the inferior median crest on the brachium obsolete; hand a little wider than brachium, its width less than length of hand-back, which is less than half the length of the movable digit; digits scarcely sinuate, the movable furnished with 16–17 median rows of teeth, the teeth of the internal series not far removed from the apices of the median rows behind them and lying well behind the middle of the rows that pass in front of them.

Legs hairy, crests on the femora granular, on the rest of the segments smooth; feet armed below with two parallel series of short, close-set spines, there being 5 on each row on the anterior foot and 8 on the posterior; some similar but rather larger spines, which gradually pass proximally into slender setæ, occur upon the distal tibial segment.

The pectines are furnished with 33–34 teeth and extend beyond the apex of the coxa.

In the ♂ the digits are basally lobate but still contiguous, and the hand is a trifle wider than in the ♀. The pectines, moreover, extend to the distal apex of the 4th trochanter and have 39–41 teeth.

Measurements in mm. of ♀ (type).—Total length 90, of cara-

pace 10, of tail 53; length of 1st segment 6·5, of 2nd 7·5, of 3rd 8, width of the same 6·8, 6·5, 6·2; width of brachium 3·3, of manus 4; length of hand-back 5·9, of movable digit 12·5.

Loc. Muscat (*A. G. Jayakar*).

It is interesting to note that these adult specimens more nearly resemble the young of *dimidiatus*—*i. e.*, assuming that I have correctly identified the young of that species—than they do the adults. We may conclude from this that the young of the two species will prove to be indistinguishable, which is sometimes the case with closely allied forms.

Buthus alticola, sp. n. (Pl. IX. fig. 3.)

♂. *Colour.* Carapace and anterior six terga blackish green; 7th tergum, tail, legs, and palpi flavous or ochraceous; digits of palpi brown with clear yellow tips (lower surface of tail perhaps partially olivaceous); mandibles infuscate distally in the exposed part.

Carapace coarsely granular and keeled as in *judaicus*, but the intercarinal area behind the eyes less granular than in that species; as long as the 1st caudal segment and one quarter of the 2nd, and as long as the 4th caudal segment.

Terga coarsely granular and strongly keeled, the three keels on all the terga except the 1st strongly dentiform posteriorly; the granules on the sides of the terga subserially arranged; on the 7th tergum the two lateral crests on each side are united by a transverse row of granules, as in *judaicus*.

Sterna smooth; the external crests on the last weakly granular, anteriorly and posteriorly abbreviated, the median ones smooth, extending from the posterior border past the middle.

Tail long, slender, and low, nearly 6 times as long as the carapace, gradually narrowed posteriorly, the sides of each segment nearly straight and parallel; the 1st segment longer than wide, the 2nd, 3rd, and 4th increasing in length, the 4th twice as long as wide; 10 keels on the 1st, 2nd, and 3rd, the median lateral on the 4th represented by a few low granules; all the keels granular, the inferior median on the 1st and 2nd, however, almost smooth, the granules on the upper crests increasing in length posteriorly, the terminal granules on the upper keel of the 4th dentiform; the upper surface of segments 1–4 smooth, except for a few serially arranged granules; the area between the superior and the superior-lateral crest also serially granular, the rest of the intercarinal spaces tolerably

smooth; 5th segment with the sides of its upper surface granular, its lateral surface also finely granular, lower surface with the granules forming two intervening crests. *Vesicle* globular, wider than high, granular below; aculeus longish.

Palpi long, humerus as long as the carapace; brachium three times as long as wide, with the two superior crests well developed and granular, the upper crest of the posterior surface also present; manus long and wide, much wider than the brachium, smooth, punctured, its width about two-thirds the length of the hand-back, and the hand-back about two-thirds the length of the movable digit; digits separated at the base, lobate and sinuate; movable digit with 14 (15) median rows of teeth.

Legs with smooth coxæ and granularly crested femora; tarsi with two parallel rows of black spinules beneath; the distal tibial segment also with a row of spinules on its posterior side.

Pectines surpassing the 4th coxæ; with 29 teeth.

Measurements in millimetres.—Total length 81, of carapace 9, of tail 52·5; width of 1st segment 5·8, of 4th 4·5, of manus 4·8, of brachium 3; length of movable digit 12.

Loc. Chitral, Hindu Kush, 5000 ft. (*Capt. Younghusband*).]

Genus PRIONURUS.

In his recent revision of the Scorpions of the family *Androctonidæ*, Prof. K. Kraepelin has recognized two species as composing the genus *Prionurus* (called by him *Androctonus*). These are *funestus* of Hempr. & Ehrenb., which is identical with *australis* of Linnæus, and *crassicauda* of Olivier; and on pp. 20–28 he has compiled a series of most elaborate tables of comparative measurements of the species he calls *funestus*. One cannot but admire the patience and labour displayed in this work; but to my mind the efforts that have been made to show the variability of this species are of but little value, inasmuch as they have been carried out without any regard to geographical distribution. Our author, in fact, begs the whole question, by assuming what in reality has to be proved, namely, that he is dealing with but one species. It is evident that similar tables could be prepared for every *genus*, and with the exercise of a little ingenuity the whole of the *Buthidæ* could be reduced to but one species.

Turning, however, to the facts, we find that he establishes the characters of his so-called species *funestus* upon 150 examples.

Whether these specimens all come from one locality or 150 localities, we are not informed. Probably some were from Algeria, some from Egypt, and possibly some from Syria. But we cannot learn from the treatise whether any variation in structure was noticed between the Algerian and the Egyptian forms. All the information that we get is the table of measurements, which may have been taken from a dozen species, a brief diagnosis, which also may apply to a dozen species, and the loose statement that the species extends from Marocco to Arabia. Now I venture to say, although with all respect to Prof. Kraepelin as a most able and careful worker, that this is not the method of monographing a genus that yields results of any permanent value. Every systematist should remember that naming a species is only a means to an end—the end which should always be kept in view being the discovery as to what is the relationship between a species and its environment, and the primary work of the systematist is to point out whether structural variation is correlated with differences of distribution or not. In a large majority of cases we know that there is such a correlation in terrestrial animals; and when in any case it has been definitely established, the systematist may, to assist the recollection of the fact, assign a name to the local form and call it a species, subspecies, or variety, as he pleases. And if this has been done, it is clearly the duty of a monographer carefully to examine the evidence for and against the opinion of his predecessors, and not carelessly and without comment to discard as synonyms the names that they have proposed.

Now this so-called species *Prionurus funestus* furnishes a good instance of what has been said. When Ehrenberg went to Egypt he found that on the coast near Alexandria a particular form was found: this he called *libycus*. But not being acquainted with the differences between the young and the adult, be further assigned a name to the young of *libycus*, calling it *melanophysa*. Proceeding up the Nile, he found in Upper Egypt and in Nubia another form which he at once recognized as different from *libycus*: to this he gave the name *citrinus*. Still further to the south, in Dongola, he came across another form which he looked upon as different from *citrinus*, and named *funestus*.

Later on C. Koch obtained in Algeria a form which he saw from Ehrenberg's figures was not known to occur in Egypt. To this he gave the name *hector*; but he also had another example,

apparently cospecific with *hector*, but ticketed Java *, to which he gave the name *priamus*, apparently on account of the difference of locality.

In this case then we have to deal with (1) an Algerian form *priamus* (=*hector*); (2) a Lower Egyptian form *libycus* (=*melanophysa*); (3) an Upper Egyptian and Nubian form *citrinus*; and (4) a Nubian form *funestus*. Now clearly the question that Prof. Kraepelin ought to have asked himself with regard to these so-called species is:—"Do they breed true in their own territories, or do *citrinus* parents produce indiscriminately some offspring like themselves and some presenting the characters of *priamus* and *vice versa*?" If the latter were so, then there would be justification for the view that the species are invalid. But he does not furnish us with a particle of evidence that such is the case. If even he had examined specimens from all over N. Africa and could show that, *e. g.*, the *citrinus*-form and the *priamus*-form are linked by such a fine series of gradations that it is impossible to say where one begins and the other ends, then no one would have remonstrated with him for stating that they are the same species. But we look in vain through his 'Revision' for any evidence to establish such a conclusion, and we actually cannot find out where the specimens he had under his hands came from. We are consequently compelled to accept or reject the authoritative statement that there is only one yellow species of *Prionurus* inhabiting North Africa, without being able to discover upon what evidence such a statement rests.

But the splendid material of *Prionurus* brought by Dr. John Anderson from Algeria and Egypt affords me good grounds for thinking, firstly, that *P. citrinus* is a distinct species from *P. libycus*, and secondly, that *P. libycus*, although very closely related to *P. priamus*, is not quite the same thing. I think it likely that the distinctions between the two will break down when we know more of the *Prionuri* which inhabit the countries lying between Algeria on the west and Egypt on the east. But provisionally they may be regarded as subspecies of *australis* of Linnæus, although what *australis* of Linnæus may be, in the strictest sense of the word, is more than I can tell. Thorell, who has seen the type of *australis*, says that it is specifically identical

* This is of course not the correct locality. If we are to trust C. Koch's works, Java is a much favoured island so far as Scorpions are concerned, having, in addition to its own population, aliens from most of the other quarters of the globe.

with *funestus*, but I am not aware that he ever compared the type or even a topotype of *funestus* with *australis*, and since he is of opinion, with Kraepelin, that *citrinus* and *libycus* are cospecific, his statement about the identity between *australis* and *funestus* must be taken *cum grano salis*.

PRIONURUS LIBYCUS, *Hempr. & Ehrenb.*

Prionurus libycus, *Hempr. & Ehrenb. Verh. nat. Fr. Berlin*, i. p. 357 (1829); *iid. Symb. Phys., Zool., Scorpiones*, no. 8, pl. ii. fig. 1.

Prionurus melanophysa, *iid. ibid.* no. 11, pl. ii. fig. 8 (young).

Ehrenberg gives as the locality for this form "on the Libyan shore between Alexandria and Siwa, and the mountains of Sinai." Dr. Anderson sent home a long series of forms from Mersa Matroo, 150 miles west of Alexandria, also examples from the Pyramids and Abbasiyeh. Amongst those from Mersa Matroo are examples of all ages and both sexes, ranging in length from about 25 to 95 mm. But in addition to those obtained by Dr. Anderson, the British Museum has others ticketed Egypt, making in all a total of 28 specimens.

In the young the whole animal is flavous, with the exception of the poison-vesicle, the 5th segment of the tail, and the lower part of the 4th segment, which are a deep blackish green. With growth their blackness gradually fades away; but it never appears to die out altogether, and in some apparently adult examples it is still very manifest. The hands of the chelæ are at all ages perfectly clear yellow, a character which forms one of the best features for distinguishing this subspecies from the Algerian, to which Koch has given the two names *priamus* and *hector*, and in which the hands (and fingers in part) in the young, and even in many large examples, are deep blackish green.

Of this Algerian form *priamus* the British Museum has 37 examples from the following localities in Algeria and Tunisia, namely, Algiers, Duirat, Tuggurt, Biskra, and Tunis. Most of these are adult or half-grown specimens, but amongst the series of 12 from Biskra are examples ranging from 22 to 102 mm.

PRIONURUS CITRINUS, *Hempr. & Ehrenb.*

Prionurus citrinus, *Hempr. & Ehrenb. Verh. nat. Freunde Berlin*, i. p. 356 (1829); *iid. Symb. Phys., Scorpiones*, no. 6, pl. ii. fig. 2.

Of this form Ehrenberg says "not uncommon in Upper Egypt and Dongola." Dr. Anderson has brought back specimens from the following localities:—Cairo, Amarna, S.W. Bank of the Suez Canal, Fayum, Assouan (1st cataract), and Wadi-Halfa (2nd

cataract). A single specimen was obtained at each of the five first-mentioned places, and 17 at the last. This long series from one spot is peculiarly interesting, inasmuch as it clearly shows the characters of the species at all stages.

The largest example that I have seen is a ♀ from Assouan measuring 94 mm. The smallest specimen, from the S.W. Bank of the Suez Canal, measures 27 mm., and the largest (♂) about 83. The species is entirely pale yellow at all ages, thus differing from the two forms mentioned above as *libycus* and *priamus*. The tail in young forms is quite like that of the genus *Buthus*, the upper surface of the 5th segment being flat and the angles squared, though granular. This is even the case in specimens of about 60 mm. in length. Moreover, even in examples of this size the tail is narrowed from base to apex, the 1st segment being slightly wider than the 3rd.

In adult examples of both sexes the 3rd segment is slightly wider than the 1st, the 1st and the 4th being about equal in width, and the 5th distinctly narrower than the 1st. The superior caudal crests are elevated, but the strong elevation so characteristic of *libycus* and *hector* is noticeably absent. Consequently the posterior segments of the tail are very narrow and low as compared with those of *libycus* and *hector*. Lastly *citrinus* may be also recognized from the two last-named by its very much straighter aculeus. The young again differs from the young of *libycus* in having the digits of the chelæ shorter and much straighter. In this character as well as in the thinness of its tail these young examples offer a striking resemblance to adults of *Buthus leptochelys*.

PRIONURUS BICOLOR, *Hempr. & Ehrenb.*

Prionurus bicolor, *Hempr. & Ehrenb. Verh. nat. Freunde Berlin*, i. p. 358 (1829); *iid. Symb. Phys., Scorpiones*, no. 9, pl. ii. fig. 4.

Specimens were brought from the following localities: Cairo, Ramleh, Manadra, Aboukir, and Mersa Matroo (150 miles W. of Alexandria); but the species is evidently not so common in Egypt as the "yellow" Scorpions.

All systematists of late years who have worked at Scorpions (including more especially Simon, Thorell, and Kraepelin) have identified this Egyptian species as *crassicauda* of Olivier, with the name *bicolor* as a synonym. But all the evidence upon which I can lay my hands shows that *crassicauda* of Olivier is quite a different species, which does not occur in Egypt at all. It is true that Olivier

stated he had seen it in Egypt; but such a statement is, I think, not of much value. The Scorpion that Olivier described as *crassicauda* he mentioned expressly in connection with Cachan (Kashan, between Ispahan and Teheran, below the 40th parallel), and the figure that he gives is presumably taken from a specimen from this locality. Moreover he affirms that in addition to Persia the species is met with in Baghdad and Mesopotamia (and Egypt). His description is brief but concise and to the point. It may be epitomised as follows:—length 3 inches; colour brown, with legs and chelæ sometimes yellower; 26 pectinal teeth; 2nd, 3rd, and 4th caudal segments with only 8 crests*. The figure that he publishes is also fairly good, and amongst other things it shows that the manus is of the thickish type with the digits short.

In the British Museum collection there are specimens ticketed Persia, Bushire, Persian Gulf, Baghdad, and Midian, which are indisputably identical with Olivier's *crassicauda*. The largest example, a ♀ from Midian, measures 83 mm., which is just over 3 (French) inches, and the smallest, from the same locality, is about 45 mm. In the adults of both sexes, as in *citrinus*, *libycus*, and *priamus*, the manus is thicker than the forearm; the colour is a chocolate-brown, sometimes blackish, the tips of the legs and of the digits being paler. As stated by Olivier, the median lateral crest on the tail is complete only on the 1st segment, being represented by 2 or 3 granules on the 2nd. I have counted as many as 31 pectinal teeth on a ♂ from the Persian Gulf, and as few as 25 on a ♀ from Bushire.

This species and *bicolor* may be recognized as follows:—

PRIONURUS CRASSICAUDA (*Oliv.*).	PRIONURUS BICOLOR, *Hempr. & Ehrenb.*
Median lateral crest on 2nd and 3rd caudal segments represented merely by a posterior row of 3 or 4 granules.	Median lateral crest on 2nd and 3rd caudal segments well-developed and extending right past the middle of the segment.
The intercarinal space on the sides and lower surface of the tail not so closely and finely granular, at most sparsely so.	The intercarinal spaces on the sides and lower surface of the tail shagreened with fine granulation.
Tail much narrower, *e. g.* 3rd segment only a little wider than long; aculeus shorter.	Tail much stouter, the width of the 3rd segment much greater than its length; aculeus longer.

* Voyage dans l'Empire Othoman, etc. v. p. 172 etc., (esp. in note), pl. 42. fig. 2 (1807), 8vo.

In the adult ♂ and ♀ the manus is wide, wider than the brachium.	In the adult ♂ and ♀ the manus is narrow, not wider than the brachium.*
Pectinal teeth in ♂ up to 34, in ♀ down to 25.	Pectinal teeth in ♂ 25–27, in ♀ 19–20 (23).
Loc. Mesopotamia and Persia.	*Loc.* Egypt.

This brief diagnosis of *P. crassicauda*, Oliv., shows that the species is very nearly allied to those that Kraepelin has diagnosed under the name *funestus*. Mons. Simon was I believe the first to attempt to define the differences between the dark coloured species of *Prionurus*. He recognized two forms, namely, *crassicauda* (Oliv.) from Persia and Syria, and *æneas* of C. Koch from Algeria; but he was wrong in supposing *bicolor* of Hemprich and Ehrenberg to be the same as *crassicauda* of Oliv. I suspect that the Algerian form to which C. Koch gave the name *æneas* may prove to be distinguishable from both the Egyptian and the Persian species; but I have not seen a large enough series of specimens from that country to be able to speak with any certainty on the point.

Genus Parabuthus, *Poc.*

What I have said above respecting Prof. Kraepelin's revision of *Prionurus* applies perhaps with even greater truth to his discussion of the genus *Parabuthus* (*Heterobuthus*). He admitted only two species of this genus—one named *liosoma*, Hempr. & Ehrenb., and the other *brevimanus*, Thorell. But he certainly mixed up several valid species under *liosoma*. The following, for instance, cannot possibly be confounded with it:—*P. villosus*, Peters, from Hereroland, Congo; *P. fulvipes*, Simon, from S.W. Africa; and *P. planicauda*, Poc., from Cape Colony. I suspect that the last-named species will be found to have the following synonymy: *P. capensis*, Hempr. & Ehrenb., = *P. iros*, C. Koch, = *P. segnis*, Thorell, = *P. planicauda*. But whatever its name and synonymy may be, there certainly is in Cape Colony a common species, of which the Museum has now about 50 specimens, which is perfectly distinct from *P. liosoma*.

Parabuthus Hunteri, sp. n.

I venture to propose a new name for a form occurring on the west coast of the Red Sea, and nearly allied to the typical Arabian *liosoma*.

* It is highly improbable that all the Egyptian examples which have been described and figured are immature.

The colour of the legs, palpi with the exception of the palely infuscate digits, and first three segments of the tail is a very clear pale yellow; the anterior six abdominal terga, with the exception of their lateral portions, and usually the ante-ocular area of the carapace are darker; while the 4th and 5th segments of the tail and the vesicle are a deep greenish black or brown. The dark colour on the vesicle appears at a very early age, specimens only 30 mm. long showing it very clearly; whereas in the typical *liosoma* the vesicle remains for a long while perfectly pale. This is noticeable in specimens of about 70 mm. in length; and is well shown in Ehrenberg's figure of his type, which came from Gumfuda in Arabia. *P. Hunteri* may be further recognized by its much more slender tail. This difference, which at once strikes the eye, may be easily shown by the following measurements, taken from a ♂ example of *P. liosoma* from Aden (*S. R. Shopland*), and a ♂ of *P. Hunteri* from Duroor, 60 miles north of Suakin. These examples have the carapace of the same length, *i. e.* 10 mm.

♂ *liosoma.*—Total length 95 mm., carapace 10, tail 60; length of 1st segment 7·5, width 7·8; length of 2nd 8·8, width 8·3; length of 3rd 9, width 8·6; length of 4th 10·5, width 8·8; length of 5th 11, width 7. Width of brachium 3·4, of manus 4·5; length of hand-back 6·2, of movable digit 9·3.

♂ *Pentonii.*—Total length 100 mm., carapace 10, tail 66; length of 1st segment 8·6, width 7·5; length and width of the rest as follows: of 2nd 9·8, 7·8; of 3rd 10, 8; of 4th 11·3, 7·6; of 5th 12·5, 7. Width of brachium 3·4, of manus 5; length of hand-back 6·5, of movable digit 9·3.

Corresponding differences obtain in female examples; and although subject to a certain amount of individual variation, they appear nevertheless to be constant on the whole.

A further distinction that may be noticed in the male is the presence in *P. Hunteri* of a tubercle lying at the base of each digit of the chela; that on the immovable one is of considerable size, that on the movable is much smaller and closer behind the other. These tubercles are not present upon any of the males of the typical *liosoma* that I have seen, even upon the largest, and presumably therefore the oldest.

The largest male of *Hunteri* that I have seen is 113 mm. long.

Loc. Duroor, 60 miles N. of Suakin (36 specimens); Suakin (2 specimens obtained by Surgeon-Captain Penton).

I dedicate this species to Colonel Hunter, lately Governor of the Red Sea Littoral.

[I subjoin descriptions of two new species of *Parabuthus* allied to *liosoma*.

PARABUTHUS GRANIMANUS, sp. n. (Pl. IX. figs. 4–4*d*.)

? Buthus villosus, *Simon, Ann. Soc. Ent. France*, 1890, p. 130; *not of Peters*.

♀. *Colour* of trunk and palpi reddish or blackish brown; tail with segments 1 to 3 clear yellowish brown, segments 4–5 and the vesicle piceous, the 5th segment of the tail rather paler beneath than the 4th; mandibles, legs, and sternal surface of the trunk clear ochre-yellow, the femora of the legs sometimes a little darker than the rest of the segments.

Trunk as in *P. liosoma*; carapace granular throughout, except for a smooth area on each side of the tubercle.

Tail almost six times the length of the carapace, nearly parallel-sided; segments 1 and 4 equal in width, 2 and 3 very slightly wider than the 4th, the segments all low, as in *liosoma*, the 4th a little lower than the first; all long and narrow, with sides lightly convex, much longer as compared with their width than in *liosoma*, all much longer than wide, the width of the 4th a little less than the length of the 1st and much less than the length of the 3rd (in *liosoma* the width of the 4th is much greater than the length of the 1st and equal to that of the 3rd); the vesicle large, its width equal to the width of the lower surface of the 5th segment between the keels (*cf.* measurements).

Palpi more coarsely granular than in *liosoma*; the manus, instead of being smooth as in *liosoma*, is covered thickly with squamiform granules; moreover, it is wider than in *liosoma*, being slightly wider than the brachium, which is coarsely granular all over.

The first abdominal sternum beneath the pectines perfectly smooth (finely granular anteriorly and laterally in *liosoma*).

♂. Differing from the ♂ of *liosoma* in exactly the same features as the ♀; the manus considerably wider, with the digits lobate as in *P. Hunteri*.

Measurements in millimetres.—♂. Total length 96, length of carapace 9·8, of tail 62; length and width of the segments—1st 8, 7; 2nd 9, 7·3; 3rd 9·5, 7·3; 4th 11, 7; 5th 11·5, 6·5; width of vesicle 5; width of brachium 3·3, of hand 5·2; length of hand-back 7·3, of movable digit 8·7.

♀. Total length 110, of carapace 12·5, of tail 72; length and width of the segments—1st 9·2, 8·2; 2nd 10·4, 8·8; 3rd 10·6, 8·8;

4th 12·5, 8·5; 5th 13·5, 7·8; width of vesicle 7; width of brachium 4, of hand 4·2; length of hand-back 5·6, of movable digit 12.

The measurements of the ♂ may be compared with those of the ♂ of *liosoma* and *Hunteri* given above. From this it is apparent that in having the tail long and slender *granimanus* and *Hunteri* are much alike, but that the manus is larger even than in *Hunteri* and is, in addition, covered with granules.

The measurements of the ♀ may be compared with the following taken from a ♀ of the typical *liosoma* from the crater at Aden. Total length 118, of carapace 12·5, of tail 70; length and breadth of its segments: 1st 9, 9·3; 2nd 10, 10; 3rd 10·5, 10·2; 4th 11·8, 10·3; 5th 13, 8·8; width of vesicle 7, of brachium 4, of manus 3·8; length of hand-back 5·5, of movable digit 12·7.

This shows clearly that the tail in *liosoma* is much thicker and shorter. Of the latter the Museum has 59 specimens from S. Arabia.

Loc. Zeyla in Somali-land. 5 specimens, including types of ♂ and ♀, obtained by Mr. E. W. Oates. Also two examples of apparently the same form, but paler, from the Somali coast presented to the British Museum by H. M. Phipson: the larger of these is a ♀ measuring 120 mm., the carapace being just over 12 and the tail 75. And two others (♂ ♀) from the crater at Aden, the ♀ measuring 128 mm., of which the tail is 79 and the carapace 13·2. These two examples are of peculiar interest, because from the fact that they were taken in company with a large number of examples of the typical *liosoma*, it appears that the two remain perfectly distinct in the same spot, and exist side by side without blending.

The Museum also has a ♀ example of apparently this form from Massowah, and another nearly allied form from Kilimanjaro and Mianzine obtained by Mr. F. J. Jackson. But more material is required from these latter localities before we can be sure of the identity of the two specimens.

PARABUTHUS PALLIDUS, sp. n.

Colour. Legs, mandibles, palpi, tail, and lower side of trunk entirely pale yellow; carapace and terga darker, reddish or brownish yellow.

Carapace as long as tail-segments 1st + $\frac{1}{3}$ of the second, entirely covered, including the ocular tubercle and the area immediately below the median eyes, with fine granules.

Terga also covered with granules, which are exceedingly fine

in the front half of each, but rather coarse in the posterior half; the median crest small, extending from the 2nd to the 6th. *Sterna* smooth; the last at most finely shagreened, with the 4 keels very weak.

Tail about $5\frac{1}{2}$ times the length of the carapace, gradually expanding to the middle of the 4th segment; the upper surface of the segments 1 and 2 hollowed and mesially grooved; upper surface of segments 3–5 smooth, polished; segments 1–3 with 10 keels, all of which are coarsely granular, except the two inferior keels on the 1st, the same two keels on the 2nd and 3rd composed posteriorly of dentiform tubercles; the inferior lateral keels on segments 1–3 strongly converging behind; the superior keels on segments 1–4 evenly granular; the lateral and inferior intercarinal spaces granular, except those on the lower surface of the 1st, the granulation becoming thicker on the posterior segments; on segment 4 the lower surface is completely and closely granular, the two inferior keels obsolete, visible only in the anterior third of the segment; the 5th segment completely granular at the sides and below, the superior keels without any enlarged granules or tubercles, and with scarcely a trace of any enlarged serially arranged granules on the lower surface between the median and the lateral keels; the granules on the lateral keels becoming tubercular behind, the 3rd from the end abruptly enlarged and quadrate; the lobe on each side of the anus large and squared, and not secondarily lobate. 1st segment wider than long *, 2nd as long as wide, 3rd a little longer than wide, 4th and 5th longer than wide; length of 3rd a shade less than width of the 4th, the height of the 4th equal to the length of the 1st, the height of the 3rd and 2nd only a little less, height of the 4th about $\frac{2}{3}$ the length of the 5th.

Vesicle coarsely granular below, considerably wider than high.

Palpi short; humerus granular and crested above; brachium smooth and punctured behind, coriaceous above, granular in front; manus entirely smooth and punctured, narrower than the brachium; the length of the hand-back about half the length of the movable digit, and about $\frac{1}{3}$ longer than the width of the hand; digits short, not lobate, only slightly curved, with 10 median rows of teeth, and 11 teeth forming the inner series.

Legs with femora and patellæ of 3rd and 4th granular, for the rest smooth.

* Length is taken laterally from the posterior border to the large tubercle which marks the point of origin of the two upper keels.

Pectines projecting beyond the apex of the 4th coxæ, furnished with 29–30 teeth; the basal lobe large and long.

Measurements in millimetres.—Total length 66, of carapace 7·5, of tail 41; width of 1st segment 5·5, of 4th 6·3, length of latter 7, height 5; length of 5th 7·6, height 4, width 5·5; length of manus and digits 10·5, of movable digit 6·6.

Loc. Mombasa (2 specimens).

This species differs markedly from *liosoma* and its allies in the uniform colouring of the tail, as well as in having the segments of this organ much more elevated.]

NANOBUTHUS, gen. nov.

Movable jaw of mandible armed below with one small tooth behind the terminal fang; immovable jaw unarmed below.

Digits of the chelæ with their proximal third unarmed; the distal portion armed with only 5 median rows of minute denticles accompanied by short oblique rows, each composed of 3 (2) exceptionally strong sharp conical teeth, the apex of the digits being occupied by 6 of these large teeth.

Genital operculum very large and long, each half about twice as long as wide, with strongly convex posterior border and emarginate external border, more than twice as long as the triangular deeply impressed sternum.

NANOBUTHUS ANDERSONI, n. sp.

Colour. Trunk infuscate above, the posterior and lateral borders of the terga ferruginous; palpi, legs, and tail pale yellow, the latter organ very slightly infuscate at its base; its 5th segment also lightly infuscate below; the lower surface of the trunk pale olivaceous; pectines yellow.

Carapace about as long as the 1st caudal segment and half the 2nd, granular throughout; median eyes widely separated; keels almost entirely obsolete, the anterior and posterior median alone represented by a few larger more polished granules. *Terga* granular throughout; the lateral keels very weak; the two lateral keels on the 7th also very weak. *Sterna* smooth, the last weakly granular posteriorly; the 4 keels, especially the external ones, very poorly developed.

Tail narrowed behind, about 5½ times the length of the carapace; the superior keels weak on the 1st segment and practically absent on the rest, the upper edges being evenly rounded; the upper surface excavated on the 1st, 2nd, and 3rd, the 4th and

5th less noticeably excavated; the lateral keels weak, the median lateral visible on the 2nd and on the hinder half of the 3rd; the 4 inferior keels normally strong on 1st segment, much stronger on the 2nd and 3rd, the median invisible on the 4th, which is simply granular below; the inferior and lateral intercarinal spaces of the segments 1–4 granular; 5th segment coarsely granular below the lateral keels, posteriorly strongly lobate or bluntly dentate, the edge on each side of the anus produced and lobate, as in *europæus*. *Vesicle* moderately large, angled beneath the aculeus, which is as long as the vesicle and lightly curved.

Palpi weak; humerus and femur granular and carinate; brachium and manus smooth and not carinate, but coarsely punctured; manus small, narrower than brachium; digits short, the movable less than twice the length of the hand-back, not lobate; manus and digits together only a little longer than the carapace.

Legs granularly crested; feet with two series of setæ below.

Pectines with 16–17 teeth.

Measurements in millimetres.—Total length 28, of carapace 3·5, of tail 17, width of 1st segment 2·3, of 5th 1·8.

Loc. Duroor, 60 miles north of Suakin.

EXPLANATION OF PLATE IX.

Fig. 1. *Buthus anthracinus*, sp. n., nat. size.

1 *a*. " " Lateral view of tail.

2. " *Jayakari*, sp. n., nat. size. ♀.

2 *a*. " " Extremity of tail.

3. " *alticola*, sp. n. Extremity of tail.

4, 4 *a*. *Parabuthus granimanus*, sp. n. Upper and lateral views of tail of ♀ specimen from Zeyla, in which the carapace measures 12·5 mm. (nat. size). To compare with figs. 5 & 5*a*.

4 *b*. *Parabuthus granimanus*. Hand and arm (nat. size). ♀.

4 *c*, 4 *d*. " " Arm and hand of ♂ specimen in which the carapace measures 9·8 mm. (× 2). to show the basal lobes and granulation (compare with fig. 5*c*).

5, 5 *a*. *Parabuthus liosoma* (Hempr. & Ehrenb.). Upper and lateral views of tail of ♀ specimen from Aden, in which the carapace measures 11·5 mm. In fig. 5 the fourth and fifth segments are a shade too thick; but the figure shows very clearly the form of the tail which is typical of *P. liosoma* (*s. s.*), and differs strongly from that of *P. granimanus*.

5 *b*. *Parabuthus liosoma*. Hand and arm (nat. size) of same specimen to compare with fig. 4*b*.

5 *c*, 5 *d*. *Parabuthus liosoma*. Arm and hand of ♂ specimen of which the carapace measures 10 mm. (× 2), to show smoothness and absence of lobes on fingers.

PLATE IX. (*continued*).

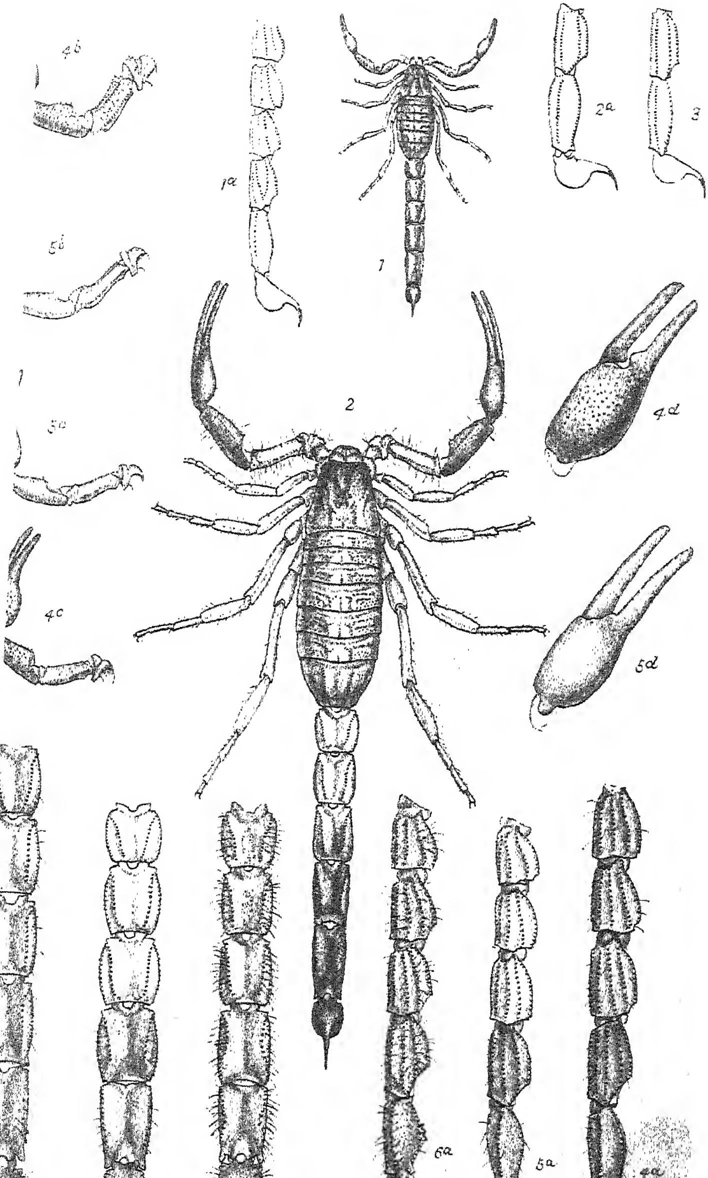
Figs. 6 *a*, 6 *b*. *Parabuthus villosus* (Peters). Upper and lateral views of tail of ♀ example from Benguela (W. Africa), in which the carapace measures 12 mm.—These figures are inserted to convince those authors, who persist in citing *villosus* as a synonym of *liosoma*, that the two are perfectly distinct. Compare the large vesicle, stout and curiously curved aculeus, the elevated 5th segment, and the straighter, more parallel-sided, more thickly hairy tail.

ADDENDUM.

List of the Scorpions obtained by Colonel Yerbury at Aden in the Spring of 1895.

1. *Hemiscorpius lepturus*, Pet. Aden (many specimens).
2. *Nebo flavipes*, Sim. Aden, Haithalhim, Shaikh Othman.
3. *Parabuthus liosoma* (Hempr. & Ehrenb.). Aden, Haithalhim, Lahej, Shaikh Othman.
4. *Buthus dimidiatus*, Sim. Aden, Lahej, Shaikh Othman.
5. *Buthus acute-carinatus*, Sim. Aden, Lahej, Haithalhim.
6. *Butheolus thalassinus*, Sim. Aden, Lahej, Haithalhim, Shaikh Othman.

This little collection came to hand whilst this paper was passing through the press. The most interesting species of the lot are the first and last of the list· *Hemiscorpius lepturus* seems to be represented by very few specimens in the collections of Europe. Up to the present time, so far as I am aware, the British Museum and the Museum at Berlin are the only institutions which possess it. The British Museum received it for the first time some two years ago, when Mr. Oates sent home one specimen from Aden. Yet, judging from Col. Yerbury's collection, the species is not uncommon in Aden; and it evidently has a wide range, since it extends at least as far to the north as Baghdad. *Butheolus thalassinus* is new to the British Museum; and the acquisition of seven specimens has filled up an important gap in our series of Scorpions. Moreover, it has enabled me to compare the species both with *Buthus Benti* and with *Nanobuthus Andersoni*. The latter differs from *Butheolus* in having the anteocular area of the carapace almost horizontal, the lower border of the immovable mandibular digit unarmed, in the partial degeneration, both in number and size, of the median rows of teeth on the digits of the chelæ and the corresponding increase in strength of the lateral teeth. According to Simon's description of *B. thalassinus*, the tail is posteriorly dilated, and there is only one inferior tooth on the immovable mandibular digit. The 3rd and 4th segments of the tail, however, are scarcely wider than the 1st, and sometimes at least there are two teeth in the position mentioned above. In both these respects the species approaches *B. Benti*; but the two are undoubtedly specifically distinct.


4b
1a
1
2a
3
5b
2
4d
5c
4c
5d
4
5
6
6a
5a
4a

On the True Nature of "*Möbiusispongia parasitica*," Duncan.

By A. Vaughan Jennings, F.L.S., F.G.S., Demonstrator of Botany and Geology in the Royal College of Science, Dublin.

[Read 6th June, 1895.]

In the Journal of the Royal Microscopical Society for June 1880, the late Professor Martin Duncan described an organism which he regarded as "a parasitic sponge of the order Calcarea," and which he named *Möbiusispongia parasitica*.

The reasons given for classing the specimen with the Sponges were decidedly inadequate, and writers of monographs on the group have been content to insert the name among doubtful and insufficiently characterized forms. It has become one of those names which reappear in lists compiled by specialists, always followed by a note of interrogation, until some later observation supersedes them.

As I have been able to examine the original specimen, and believe the appearances necessitate a very different explanation, I thought it would be of interest to exhibit the preparation to the Society: not only to relieve the students of Sponges of a doubtful genus, but because the form has also a distinct interest for those who are working at the Protozoa.

Dr. Duncan found the organism in some sections of *Carpenteria rhaphidodendron*, Möb., from Mauritius, which had been lent him by the late Dr. W. B. Carpenter.

It consists of a series of delicate calcareous sacs or chambers connected by straight stolon-tubes, lying within one of the chambers of the *Carpenteria*. Some of the stolon-tubes pass through the partition-wall of the *Carpenteria* and communicate with sacs lying in the adjacent chamber. The wall both of the sacs and tubes is a thin calcareous shell traversed by well-marked perforations and bearing short pointed spines on the exterior. The group of sacs in the chamber of the *Carpenteria* measures about a fiftieth of an inch in length by a hundredth in breadth, while some detached sacs may be found in other parts of the slide.

In 1891 the late Dr. P. H. Carpenter lent me some slides of *Carpenteria* for examination, and in the course of my study of

one of them I met with the organism under consideration. At that time I had not seen Dr. Duncan's paper, or heard of *Möbiusispongia*; but I made a note and drawing of the object as a Foraminifer of the genus *Ramulina*. A year or so later, when working at sponges, and anxious to know about *Möbiusispongia*," I referred to Dr. Duncan's paper and found it was the specimen I had drawn as a *Ramulina*.

I have no doubt that my determination is correct, and I believe that any student of the group would recognize its foraminiferal character from the original illustration.

It only remains to examine the evidence on which the organism was referred to the Sponges, and to determine, if possible, the species of Foraminifera to which it belongs.

Dr. Duncan based his conclusions, first, on the presence of "a cellular element," and secondly, on the occurrence of spicules.

The faint lines seen in places round the projecting spines are, however, only such as are frequently observed in the shells of Foraminifera, forming a sort of areolation due either to incipient cracking or to the mode of deposit of the shell-material. There is *no* trace of true cellular structure.

The spicules observed are two or three broken needles and one triradiate. All would be far too large in proportion if the body were a Sponge, and none have any actual connexion with the walls of the chambers and tubes, as was admitted in the original description. They are evidently entirely accidental.

We may therefore, I consider, safely dismiss the claims of this curious organism to rank with the Sponges, and the only question is whether it can be included in any of the known species of *Ramulina*.

The genus *Ramulina* was originally founded by Mr. Wright * for certain fossil fragments from the Chalk. Professor Rupert Jones † subsequently placed the genus on a more definite footing; and Mr. Brady ‡ adopted it for certain recent forms found in the North Atlantic and South Pacific during the 'Challenger'

* "Cretaceous Microzoa of the North of Ireland," Report and Proceedings of the Belfast Nat. Field Club, 1873–4.

† In the same publication for 1875; and in the 'Micrographic Dictionary,' 1875.

‡ H. B. Brady, 'Journal of the Microscopical Society,' n. s. xix. p. 272; and 'Challenger Report,' vol. x.

cruise. The fossil forms have been apparently confused in some cases with the *Dentalina aculeata* of D'Orbigny, and need careful revision.

Recent forms have been so far included in *R. globulifera*, Brady, which measure about a fifteenth of an inch (1·7 millim.) or more in length.

The specimen found in the chamber of *Carpenteria* differs therefore from the type in its smaller size as well as in the more sinuous and irregular shape of the chambers, but the difference seems scarcely sufficient to justify a separate specific name.

Very probably the organism was "*Polymorphine*" in its early stages like the *Ramulina Grimaldii* described by M. Schlumberger * as growing among other organisms on dead shells. Future research will doubtless reveal the existence of several species of such adherent types, and the chambers and tubes to which the name *Ramulina* was first given may be only their detached fragments.

In this case the animal in its young stage was probably surrounded by the rapidly growing *Carpenteria*, but managed to live for some time by means of the water circulating through the chamber of the larger Foraminifer. That its growth under such circumstances would be limited is very natural, and its characteristics may be regarded as due to abnormal conditions rather than to specific distinctness.

It is not likely that the *Ramulina* grew in the chamber of the *Carpenteria* after the death of the latter, as the chambers are still lined with dry sarcode while those of the *Ramulina* are empty. It is also difficult to suppose that a *Ramulina* could perforate the dead walls of a *Carpenteria* and extend its stolon-tubes into adjacent cavities.

On the other hand, if both organisms were living at the same time, either the *Ramulina* must have obtained food by taking it direct from the *Carpenteria*, or more probably the protoplasm of the latter in the living state only lines the chambers, leaving a clear space in the centre through which water can circulate.

* Mém. Soc. Zool. France, iv. (1891), p. 509. My thanks are due to M. Schlumberger for a copy of the plate illustrating his description.

On a New Genus of Foraminifera of the Family Astrorhizidæ.

By A. Vaughan Jennings, F.L.S., F.G.S., Demonstrator of Botany and Geology in the Royal College of Science, Dublin.

[Read 6th June, 1895.]

(Plate X.)

Among the dredgings made by the 'Porcupine' Expedition (third cruise), 1869, that obtained in the Faroe Channel at 440 fathoms was interesting from the number of specimens it contained of the large arenaceous Foraminifer *Botellina labyrinthica*, Brady.

While examining some of this material given me by the late Dr. P. H. Carpenter, I found that many of the specimens of *Botellina* had other Foraminifera adherent to them.

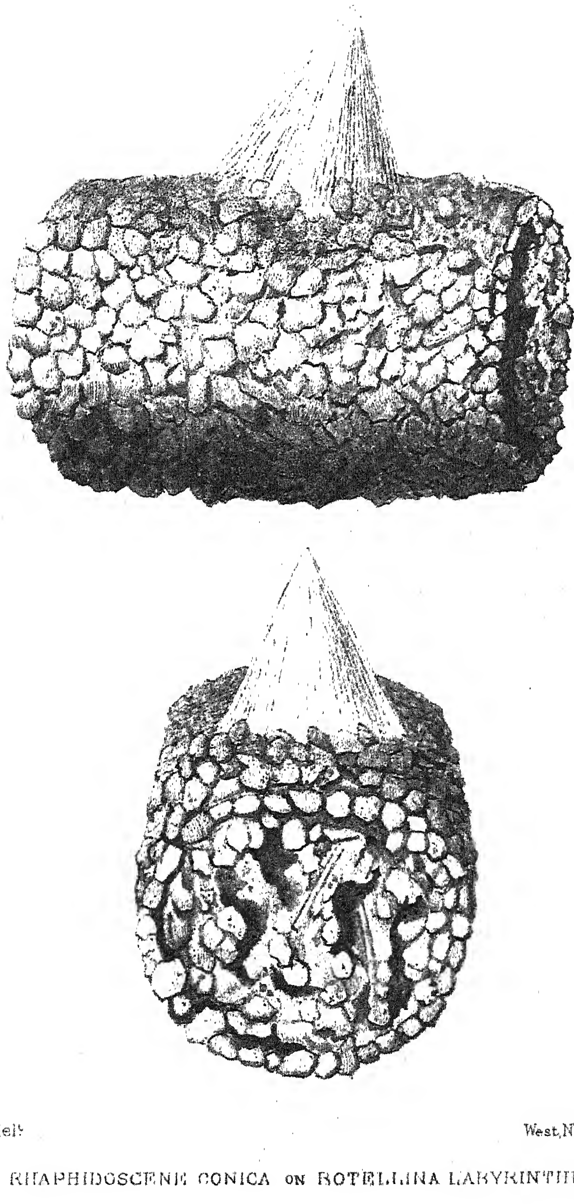
Most of these are *Truncatulina refulgens*, Montf. sp., and *T. lobatula*; but in two cases the adherent form proved something quite different—a type which has not yet, I believe, been described or named.

It consists of a tent-shaped structure, measuring about a twenty-fifth of an inch in height, with slightly less diameter at the base, composed entirely of sponge-spicules. The spicules are very regularly arranged and closely set together, all lying in the same direction, pointing from the circumference of the base toward the apex.

The spicular structure is in this case the more remarkable since there can be no question as to the abundance of other material at hand. The *Botellina* shells are constructed of coarse sand-grains, and by far the greater part of the dredging consists of similar material. In fact, the contrast between these delicate spicular cones and the coarse sandy structure of the organism on which they rest is one of the most striking instances I know of the selective power in Protozoa.

At the base the shell is fixed to the rough surface of the *Botellina* by a small amount of a white, doubtless calcareous, cement; but in the walls there is very little interstitial matter.

In the dry specimen the apex of the cone is closed; but I should think it probable that in the living condition the spicules were more or less mobile, so as to separate to some extent at the top, and allow a free passage of the protoplasm to the exterior.



A.V.J. delt. West, Newman lith.

RHAPHIDOSCENE CONICA on ROTELLINA LABYRINTHICA.

Unfortunately there is not sufficient material to submit the structure of the shell to more complete examination.

The form therefore appears to be an extremely simple type of Foraminifer, living attached to foreign bodies and building a protective roof, but with that remarkable power of selecting sponge-spicules for its building material which is shown in *Pilulina*, *Marsipella*, and *Technitella*.

In habit it is the equivalent of simple forms of *Nubecularia* in the Porcellanea, and of *Placopsilina* and *Webbina* in the Lituolidæ.

It may be objected that this spicular structure should not be regarded as a character of generic value; and that such a type as *Placopsilina bulla* might, if circumstances compelled it to build with sponge-spicules only, produce a similar shell. There is, however, a great difference in the style of architecture of forms that constantly select spicules and those that, as it were, pick them up indiscriminately with sand and shell-fragments.

In such a form as *Haliphysema* the shell may be entirely sandy or completely spicular; but as all intermediate stages occur, no one would give separate names to the extreme forms. On the other hand, the characteristic shape of *Pilulina* and *Technitella*, combined with their constant spicular character, gives them an undisputed title to generic distinctness.

The case now under consideration seems to me to be a parallel one; and in proposing a new generic name I am only following the precedent of the late Dr. H. B. Brady.

The tent-like shape and the spicular structure suggest the name of *Rhaphidoscene*.

A possible alternative would be the revival of the name *Squamulina*, first used by Schultze *. His specimens, however, seem to have been only immature individuals of *Nubecularia*; and as the best-known form referred to this genus, the so-called *Squamulina scopula* of Carter, turned out to be founded on the basal dome of specimens of *Haliphysema*, it is better that the name should be allowed to drop.

EXPLANATION OF PLATE X.

Rhaphidoscene conica on *Botellina labyrinthica*.

---

* Schultze, 'Ueber den Organismus der Polythalamien,' 1854.

On a New Species of *Distomum*. By G. S. West, A.R.C.S., Scholar of St. John's College, Cambridge. (From the Biological Laboratory, Roy. Coll. Sci. London.) (Communicated by Prof. G. B. Howes, Sec. Linn. Soc.)

[Read 6th June, 1895.]

(Plate XI.)

Whilst dissecting the head of *Philodryas Schottii* (one of the Opisthoglyphous Colubridæ), some dozen or more specimens of a small species of *Distomum* were observed in the buccal cavity and several more in the narial cavity; the narial passages were also full of eggs. On careful examination and comparison with descriptions and figures of published forms, it proves to be an undescribed species which I designate as follows:—

Distomum Philodryadum, n. sp.

Body fusiform, broadest in the middle, tapering to each end, anterior oral extremity rounded, posterior caudal extremity more or less pointed; epidermis closely beset with very minute spines, which are much fewer posteriorly; oral sucker orbicular, almost ventral in position; ventral sucker sessile, situated at about one third the length of the body from the anterior end, orbicular, and of the same size as the oral sucker. Intestine simple, œsophagus extremely short, branches long and narrow, reaching almost to the extremity of the tail. Genital pore posterior to the ventral sucker and a little to the left of the median line. Length 3–5 mm.; breadth 0·8–1·3 mm. Eggs numerous, very minute, length 0·03 mm., breadth 0·015 mm.

The snake from the mouth of which this Trematode was obtained is a Brazilian one. Curiously enough, two other species described as infesting the buccal cavities of snakes are also S. American. These two species are *D. Boscii*, Cobb. ("On some new forms of Entozoa," Trans. Linn. Soc. vol. xxii. 1859, p. 364, t. 63. f. 67), and *D. incerta*, Cobb. ("Notes on Parasites collected by the late Charles Darwin," Journ. Linn. Soc. vol. xix. 1885, pp. 177–178, and fig.). From both these species it differs in its external form, its larger ventral sucker, in the shortness of its œsophagus, and in the position of the genital pore; moreover, *D. Boscii* has a much smaller oral sucker, and *D. incerta* is quite smooth. The dimensions of *D. Philodryadum* and also of the

eggs are intermediate between these two species. *D. Barnaldii*, Sonsino ("Dei Distomi dello *Zamenis viridiflavus*, Lacép., e di una fase del ciclo vitale di unodi eiso," Proc. Verb. Soc. Tosc. Sc. Nat. Pisa, 1892, p. 92), is also from the buccal cavity of a snake. *D. Philodryadum*, however, differs very considerably from the latter species in general form, size, position of the genital pore, &c.* Of the species of *Distomum* described as infesting other parts of snakes, those most nearly approaching *D. Philodryadum* are *D. variabile*, Leidy ("A Synopsis of Entozoa and some of their ecto-congeners observed by the Author," Proc. Acad. Nat. Sc. Philad. 1856, p. 44), and *D. signatum*, Dujardin ('Histoire naturelle des Helminthes ou vers intestinaux,' Paris, 1845, p. 414). From the former it differs in size, form, and in the ventral sucker; but Leidy does not describe the internal anatomy of his species. *D. signatum* is smaller, has the suckers much closer together, proportionately larger eggs, and the genital pore is anterior to the ventral sucker.

The œsophagus is very short and rather wide, and the two branches of the intestine appear to arise almost directly from the base of the pharynx; but the presence of an unbranched thin-walled tube posterior to the latter is clearly seen in transverse sections. The simple character of the intestine, the extreme shortness of the œsophagus, and the characters of the oral and ventral suckers place this species in Dujardin's subgenus *Brachylaimus* (Dujardin, *l. c.* p. 407; *cfr.* Bronn, 'Klass. u. Ord. Thier-Reichs,' Band 4, Würm. p. 909).

The testes may be on opposite sides of the body, one in a more anterior position than the other; or there may be one directly behind the other on the same side of the body. One vas deferens is considerably longer than the other, and the two unite just at the point where the duct enters the cirrus pouch.

In those specimens in which the uterus was greatly distended with eggs, the most anterior part of it reached almost as far as the anterior edge of the ventral sucker.

The genital orifice is situated posterior to the ventral sucker and a little to the left of the median line; its position is not

* In a paper, "Brief Notes on Flukes," P. Z. S. 1893, p. 499, Sonsino remarks that *D. Barnaldii* may prove to be *D. nigrovenosum*, Bellingham (found in *Tropidonotus natrix*). This latter is well worked out by Monticelli ("Studii sui Trematodi endoparasiti," Suppl. Zool. Jahrb. 1893).

quite constant, being only just posterior to the ventral sucker in some, and in others a considerable distance posterior to it. The penis was protruded in most of the specimens as a very considerable papilla.

The excretory vesicle extends up the centre of the body amongst the folds of the uterus for a considerable distance, and is seen in any transverse section of the posterior end of the body (fig. 5, *e.v.*).

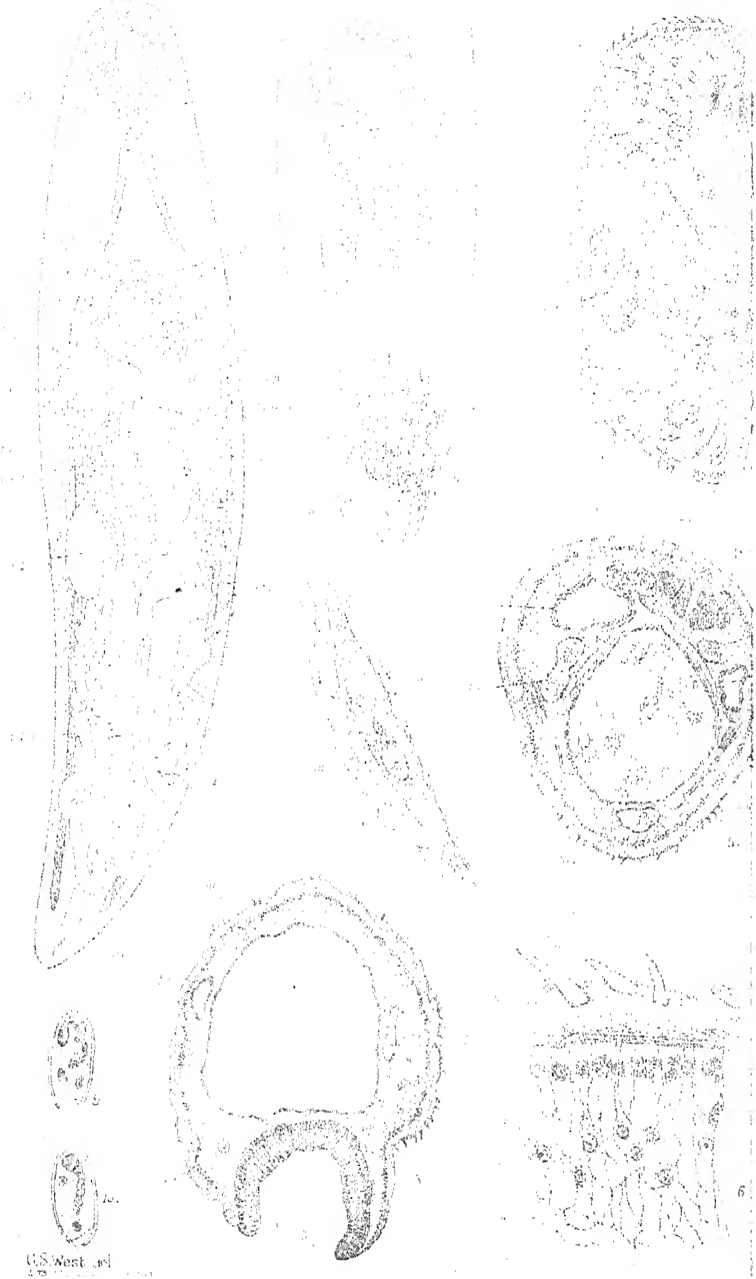
EXPLANATION OF PLATE XI.

Fig. 1. *Distomum Philodryadum*, n. sp. Animal viewed from the ventral surface, showing most of the internal anatomy.

2. Part of another animal, showing a difference in position of the genital pore.
3. Transverse section through the region of the ventral sucker; the animal had the uterus greatly distended with eggs.
4. Transverse section a little posterior to the ventral sucker.
5. Transverse section through the posterior end of the body.
6. Section showing the ectoderm, mesenchyma, and some of the muscles.
7. Transverse section through a nerve-cell.
8. Longitudinal section through a nerve-cell.

Figs. 9, 10. Two ova. × 520.

c.p. = cirrus pouch.
ec. = ectoderm.
e.v. = excretory vesicle.
g.p. = genital pore (♂ or ♀).
i. = intestine.
m. = mesenchyma.
m.l. = longitudinal body-muscles.
m.n. = nuclei of mesenchyma.
m.o. = oblique body-muscles.
n. = nerve-cell.
œ. = œsophagus.
ov. = ovary.
p. = penis.
ph. = pharynx.
r.s. = receptaculum seminis.
s.o. = oral sucker.
s.v. = ventral sucker.
sp. = spines.
t_1 and t_2 = testes.
u. = uterus.
v.d. = vas deferens.
v.s. = seminal vesicle.
vt. = vitellaria.


G.S.West del.

On the Egg-cases of some Port Jackson Sharks. By Edgar R. Waite, F.L.S., Zoologist, Australian Museum, Sydney.

[Read 20th June, 1895.]

(Plate XII.)

The Cestracions are of special interest in consequence of the vast antiquity of the family. Not only are they allied to Plagiostomes the remains of which exist in Palæozoic formations, but in the person of a living genus they date backwards to the Chalk, where they were associated, as they now are in Port Jackson, with the ancient mollusc *Trigonia*.

Five living species are known: these are:—*Cestracion Philippi*, Schneider, *C. zebra*, Gray, *C. japonicus*, Maclay and Macleay, *C. francisci*, Girard, and *C. galeatus*, Günther. In one species only—the first named—has any description or figure of the egg-case been published *. The original illustrations, being doubtless drawn from dry and distorted examples, are not very good, and from these later figures have been copied with their consequent errors.

Few particulars have been recorded as to the situations in which the living egg is usually laid, and but little definite information supplied as to the object of its peculiar form. Possessing facilities not possible to many investigators, I have collected what information I could, and have also been able to describe the hitherto unrecorded egg-case of our second species, *C. galeatus*.

The living eggs of Port Jackson Sharks are most abundant in spring (August and September), but are to be obtained throughout the summer. Empty cases are cast up on the beaches at all seasons, more especially after stormy weather. They are as common on the shores of New South Wales as are the sea-purses, or egg-cases of Dog-fishes, on English shores.

Last September (1894), Mr. Cecil W. Darley brought to me a living egg. The case was unlike any I had previously seen; from each of the basal terminations proceeded a very long filament, similar to those attached to the egg-cases of Dog-fishes (*Scyllium*). On making inquiries I discovered that such a condition was but little known, and it was suggested to me that this

* *Cf.* Duméril, Hist. Nat. Poiss. pl. 8.

was the normal state, the tendrils being afterwards broken off. A practical test dispelled this idea, for while the object was fresh or moist they could not be detached by using even considerable force.

On comparing this case with others of the usual type, I perceived that the contour was different, and suspected that we had here the egg-case of *C. galeatus*. Prof. Haswell also possessed a similar example, which he kindly placed in my hands, telling me that he thought it might prove to be distinct from that of *C. Philippi*.

Having since examined several living eggs of both species, it was found that all the simple cases contained embryos of *C. Philippi*, and all the stringed ones those of *C. galeatus*. It may be further mentioned that an example of the former species, in a tank at the Bondi Aquarium, deposited an egg without tendrils, and having the broad spirals to be mentioned later.

It appears that the eggs of *C. Philippi* are found in moderately shallow water, wedged in among rocks; whether they are actually dropped into the crevices we do not at present know; it is more probable that they are deposited on the sand at the bases of the rocks, into the fissures of which they are afterwards swept by the tide. They are so jammed crown outwards, that they can only be removed either by turning them round and withdrawing small end first, or by actually unscrewing them; both forces being most unlikely to occur under natural conditions. When empty they are somewhat more pliable, which may account for them then becoming loosened and cast ashore.

Although most rare upon the beaches, the eggs of *C. galeatus* prove to be not uncommon when sought for in their native habitat. Through the kindness of Messrs. Darley and Grimshaw, of the Harbour Department, I recently had the pleasure of searching for them fifty feet below the surface. Although not successful in obtaining specimens, I got an excellent idea of the general situation. In places immense masses of brown seaweed grow to the height of two or three feet so densely that scores of eggs may be securely concealed among them, protected by their likeness to seaweed in colour and texture. Mr. Cameron, the diver who kindly took me in charge, told me that he always finds the eggs in this weed, so attached by their long tendrils that it is scarcely possible to secure them whole, without cutting the

seaweed. In deep water they are freer from the violent disturbances, tending to detach them, to which the eggs of the more common species are subject.

The egg-cases of both species have the following points in common:—All parts are composed of a flexible horn-like substance of brown colour. The body consists of a chamber shaped like a pear; the coronal portion is compressed into a cervix through which the young Shark eventually escapes. From each side of this cervix, and integrally connected with it, arises a ribbon exactly resembling a strip of kelp. These ribbons are attached basally, their free edges turned towards the cervix and deflected considerably from the body. They pass round alternately and obliquely, and form the thread of a right-handed double screw, together making five or six turns to the base. These ribbons originate about half the width they quickly attain, and continue their course of even breadth, again narrowing on approaching the base.

The interior, as shown by a section, is wide and capacious; the fissure does not proceed to the base as is generally portrayed, but terminates some distance short of it; the inside is marked with oblique striæ corresponding with the direction of the spirals, and resembling the lines inside a vessel turned upon a potter's wheel.

The principal differences between the egg-cases of the two species may be thus recounted:—

C. Philippi, Pl. XII. figs. 1 & 2.—Of larger size; about six inches in length. The spirals are very broad and, in part, hide the body when viewed laterally; at the base they narrow quickly and terminate bluntly, and are not produced into tendrils. Beach-worn examples generally have the terminations more or less frayed.

C. galeatus, Pl. XII. fig. 3.—Of smaller size; about four inches and a half in length. The spirals are not very broad, and in no part hide the body completely; basally they become narrow and are produced into long flattened tendrils. In the most perfect specimen examined each tendril is ninety inches in length, and tapers to the slenderest thread, becoming tangled and knotted like a skein of silk. They are, however, very tough, and may be unravelled without fear of breaking. One of the tendrils terminates in a thickened tag (shown in the figure), which, although

doubtless an individual peculiarity, indicates that the tendrils are entire.

The appendages with which the eggs of Sharks are furnished serve to moor them in some suitable situation, otherwise they would be liable to be knocked about to the detriment of the contained embryo, or even washed ashore, where their destruction would be inevitable. The spiral appendages of *C. Philippi* are, as has been shown, no exception to the rule; the elastic flanges permit the egg to be forced further into a fissure, whence extraction is resisted by the free edges of the ribbon catching against the rock.

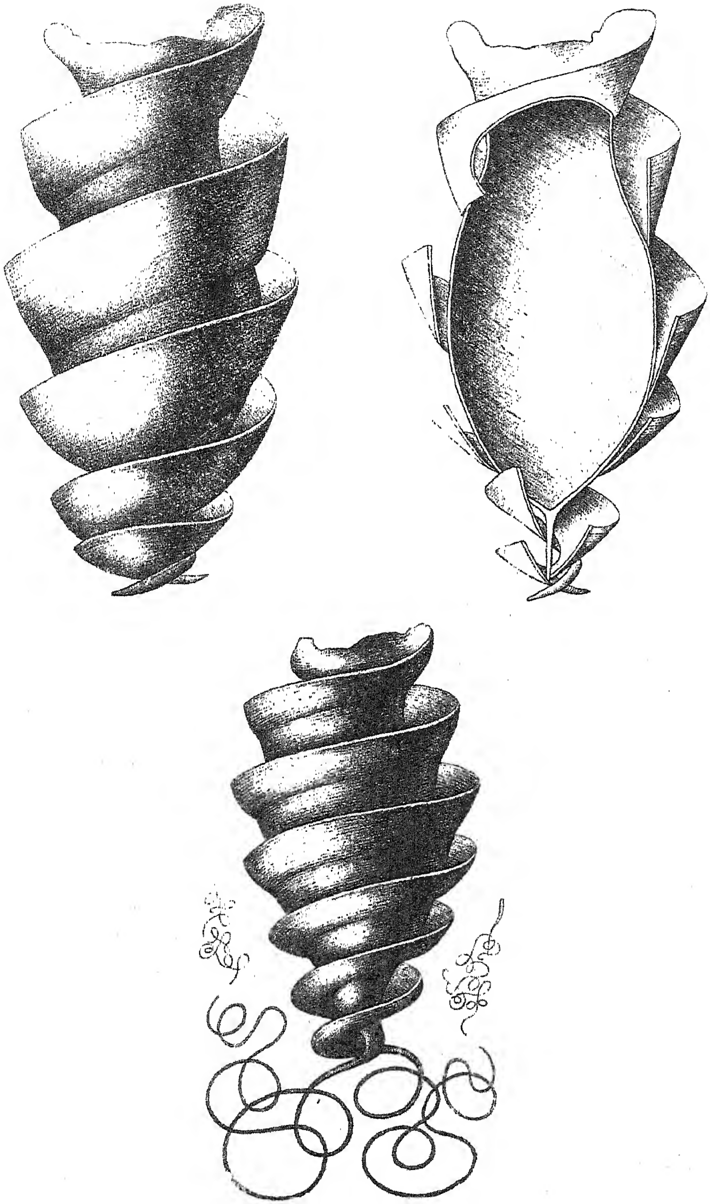
Although, in a lesser degree, the egg-case of *C. galeatus* possesses these spirals, they do not appear to have the same use; here attachment is effected by the entanglement of the tendrils among seaweed.

It may be of interest to inquire whether we are to regard the spirals or the tendrils as the primitive appendages. Seeing that *C. galeatus* possesses in its diminished spirals a useless appendage, it may be inferred that such spirals are a bequest from forms to whom they were serviceable. Also, since such a form as *C. Philippi* having larger and serviceable spirals lacks the tendrils, we infer that in *C. galeatus* the serviceable tendrils are a later development, and that the spirals, now rudimentary in function, are relics; so the feature in common between such an egg-case and those of the Dog-fishes appears to be a secondary and independently acquired character.

As before mentioned, very few theories have been advanced as to the advantage of the peculiar form of the Cestraciont's egg. An attractive explanation is offered by Mr. Grant Allen in one of his charmingly popular books *. His ingenious suggestion is as follows:—

"That well-known frequenter of Australian harbours, the Port Jackson Shark, lays a pear-shaped egg, with a sort of spiral staircase of leathery ridges winding round it outside, Chinese-pagoda wise, so that even if you bite it (I speak in the person of a predaceous fish) it eludes your teeth, and goes dodging off screw-fashion into the water beyond. There's no getting at this evasive body anywhere; when you think you have it, it

* 'Science in Arcady,' p. 169.



E. Waite del.
A. R. Hammond lith.

Hanhart imp.

EGG CASES OF CESTRACION

wriggles away sideways, and refuses to give any hold for jaws or palate. In fact, a more slippery or guileful egg was never yet devised by nature's unconscious ingenuity."

Eggs of *C. Philippi* wedged in the sheltered crevices as described could not be reached by Mr. Allen in the person of the predaceous fish, and for eggs of *C. galeatus*, closely entangled among seaweed, much dodging would be impossible. Moreover, so well are they concealed, that antics such as those described would be unnecessary.

EXPLANATION OF PLATE XII.

Figs. 1 & 2. Egg of *Cestracion Philippi*, Schneider, and section of same. ½ nat. size.

Fig. 3. Egg of *Cestracion galeatus*, Günther. ½ nat. size.

On the Structure of the Isopod Genus *Ourozeuktes*, Milne-Edwards. By A. Vaughan Jennings, F.L.S., F.G.S., Demonstrator of Botany and Geology in the Royal College of Science, Dublin.

[Read 20th June, 1895.]

(Plates XIII. & XIV.)

As long ago as 1840 Professor Milne-Edwards * gave the name of *Ourozeuktes* to an Isopod Crustacean which he had received from the late Sir Richard Owen, without information as to its habit or the locality in which it was found. He recognized it as one of the family Cymothoidæ, and gave it this generic name in consideration of the fact that all the abdominal segments are fused together, leaving in the adult only faint lines indicating the original sutures. His definition of the generic characters is clear and accurate, and the accompanying figure is a satisfactory representation of a dried specimen viewed from the dorsal surface. It gives, however, a quite inadequate idea of the appearance of the animal before desiccation, and I believe I am right in saying that no satisfactory illustration has since been published of this remarkable form.

* 'Histoire N. des Crustacés, p. 275, pl. 33. fig. 8 (1840).

Prof. Milne-Edwards's figure reappears in Bronn's 'Klassen und Ordnungen des Thier-Reichs,'* which gives also a figure of the larval stage; and more recently Messrs. Schiödte and Meinert† have described two specimens which they regard as distinct species. These also seem to be drawn from dried specimens, and add nothing to our knowledge of the morphology of the genus.

A year or two ago, while I was engaged in arranging the new Museum at the Free Public Library in Whitechapel, the Rev. Dan. Greatorex (who generously gave his collection as the nucleus of that Museum) called my attention to a curious Crustacean of almost spherical shape which he had never been able to identify. This proved on investigation to be a fine specimen of *Ourozeuktes Owenii*, which, having been preserved in spirit immediately after capture, shows admirably the natural form of the organism. It was given to Mr. Greatorex by the captain of a sailing-ship, who said it had been taken at sea near Kerguelen Island, and there seems no reason to doubt that the locality is correct.

The specimen is nearly two inches in length and more than an inch in breadth across the widest tergum; whilst the enormously developed brood-chamber below, three quarters of an inch in depth, makes the animal appear almost globular when viewed from the front. As all the previously recorded specimens seem to have been females, it is probable that, like other Cymothoidæ, the animal is hermaphrodite and proterandrous‡. The brood-chamber contained a considerable number of larvæ about 3 millim. long, all in the same stage of development.

It is unfortunate that we have no further details as to the habit of the animal, but it is almost certainly parasitic, partly or entirely. This and other general questions will, however, be best left till some account has been given of its external anatomy, so far as may be learnt from the single specimen at disposal.

* 'Arthropoda,' Band v. Abth. 2, Taf. viii. fig. 20 (1881), and Taf. xxvi. fig. 1 (1883).

† Nat. Tidskrift, vol. xiv., Copenhagen, 1884.

‡ Bullar, "Generative Organs of Parasitic Isopoda," in the 'Journal of Anatomy and Physiology,' 1876, p. 118; and Mayer, "Ueber d. Hermaphroditismus einiger Isopoden," in Mittheil. Zool. Stat. Naples, 1879.

I. *The Cephalic Region.*

The *head* is small and subtriangular in shape, sunk in a deep notch between the lateral portions of the first thoracic segment, which extend far forward on each side so that their anterior borders are on a level with the eyes and almost reach the antennæ. The *eyes* are of moderate size, situated near the lateral margin of the head, and densely pigmented. They are, of course, compound, and the hexagonal lens-areas, as in other Cymothoidæ, are comparatively few in number and large in size.

Below the anterior border projects very slightly a membranous upper lip or *labrum*.

Appendages of the Cephalic Region.

(1) The *first antennæ* are about 5 mm. in length, subulate, pointed, and composed of seven joints. They arise below the margin of the head-shield and are directed outward transverse to the axis of the body.

(2) The *second antennæ* are in general similar but slightly longer and more slender, and composed of eight joints. Their origin is immediately behind that of the first pair, and the bases of both are crossed at right angles by the mandibular palp.

(3) The *mandibles* are of somewhat unusual form. They have a strong conical base attached to the sternal region of the segment some distance back, and rather far from the middle line. From the distal end of this basal portion a much slenderer calcified rod runs obliquely forward and inward, ending in a transverse oval structure with a minute chitinous tooth meeting its fellow of the opposite side. From the anterior outer angle of the basal portion rises the soft, pointed, 3-jointed *palp*, which is directed straight forward and, as already stated, crosses at right angles the bases of the antennæ (Pl. XIV. figs. 3 & 5).

Immediately behind the terminal plates of the mandibles comes the soft bi-lobed *labium*, and the two together give a cruciate appearance when the head is looked at from the front with all the mouth-parts in place. The undersides of the labial lobes are grooved for the reception of the succeeding pair of appendages.

(4) The *first maxillæ* are reduced to a pair of cylindrical, pointed, scarcely calcified styles which arise immediately to the

inner side of the mandibles and run forward parallel to these, to end in the grooves on the labium mentioned above.

(5) The *second maxillæ* are small oblong plates rising from a short basal joint just internal to the first maxillæ. Their inner margins are slightly curved, and they terminate in front in a straight transverse fringed border behind the labial lobes.

(6) The *maxillipedes* are considerably larger, and have a wide, well-calcified base articulating somewhat obliquely with the sternal area. The main lobe is quadrate in shape, and has a thickened anterior border lying just behind the fringed margin of the second maxillæ. There is a short palp-like two-jointed lobe lying along its inner margin.

These four pairs of appendages are again covered ventrally, as far forward as the labium, by the first pair of oostegites.

Taken as a whole the mouth-parts are not strongly developed; they are comparatively feeble and soft, with little chitinous or calcareous material, indicating a suctorial rather than a masticatory habit. The mouth-aperture itself is very small and far forward, and the various appendages converge toward it. The pointed tips of the mandibles would be just strong enough to attack soft tissues, and to keep open a passage through which fluid nutriment could be ingested by the sucking action of the labium and succeeding parts.

In the case of such Isopods as live on the gills of fish, food may be obtained by such a direct or true parasitism, but a set of jaws like those of *Ourozeuktes* would probably be capable of dealing also with small organisms if the animal were in a free stage or only holding on by its hooked limbs to the outside of a fish.

With regard to the grooves in the labium in which the maxillary rods terminate, Professor Howes has kindly called my attention to the fact that in the common Crayfish the endopodite of the second maxilla runs across the labium and fits into a depression in the mandibles *.

II. *The Thoracic Region and its Appendages.*

The thoracic region consists of the typical seven segments with wide terga and well-developed epimera. The latter carry the corresponding limb-sockets, and are also prolonged down

* *Cf.* Huxley and Martin's 'Elementary Biology,' ed. 1888, pp. 199, 200.

between these to form the calcified parts of the foliaceous oostegites.

While the first tergum is, as already stated, prolonged forward on each side of the head, the last has a similar tendency to the horseshoe form, its lateral areas spreading back round the base of the abdominal region. Of the remainder the second, third, and fourth are considerably longer antero-posteriorly than the fifth, sixth, and seventh.

The seven pairs of limbs are all constructed on the same plan. A large flattened basipodite (to which is fused a small round coxopodite fitting into the limb-socket) is followed by an ischiopodite, three approximately equal joints, and a curved claw.

The flattening of the basipodite increases from before backward, and in the last four pairs the ischiopodite also becomes increasingly lamellar, so that these hinder limbs are very efficient swimming-organs.

The remaining structures belonging to the thoracic region are the large foliaceous plates or *oostegites*, which together form the great brood-chamber below the body of the animal, in which the eggs and embryos pass through their successive developmental stages. It is of course well known that such a structure occurs in many genera of Isopods and, with little difference, of Amphipoda also; but I have not as yet met with any description of one so large or fully developed as that now under consideration.

There are four of these large oostegites or plates, as they may be called for the sake of brevity, on either side of the body passing round from the line of the limb-sockets toward the ventral middle line, where the series on the left side overlaps that of the right.

It is to be noted, however, that these plates have no connexion with the limbs themselves. The calcification which supports their basal and central parts is prolonged down from the epimera, usually from the thickening in front of the limb-socket; so that the free movement of the limbs in no way interferes with the rigidity of the walls of the chamber (Pl. XIV. fig. 11).

I mention this specially, as the usual descriptions in our text-books,—such as "brood-lamellæ attached to more or fewer of the thoracic limbs,"* or "thoracic legs . . . in the female some of them provided with delicate membranous plates (oostegites) which

* 'Forms of Animal Life,' Rolleston-Jackson, 1888, p. 537.

form a brood-pouch,"*—even if they apply to other Isopoda, are not applicable to this genus.

The second pair of oostegites rise from a calcification prolonged down from the anterior region of the thickening over the second limb-socket. They overlap in front the bases of the first pair, and are, in turn, overlapped by the *third oostegites*. These rise in a similar manner from a descending calcification in front of the third thoracic limb-socket, and they overlap the fourth pair of plates behind as well as the second in front.

The *fourth oostegites* are the largest pair, and seem to be connected with the sockets of both the fourth and fifth pairs of limbs: the calcareous supporting bar derived from both these sources takes a semicircular sweep backward toward the postero-dorsal angle.

The *fifth oostegites* rise from in front of the sixth pair of limbs. They overlap the fourth pair in front, and are prolonged backward as a pair of oblong plates covering the abdominal appendages for more than half the length of that region of the body, and by pressing on the large first abdominal appendages completely close the brood-chamber behind.

These four pairs of plates form by far the greater part of the wall of the brood-chamber; but between the anterior margins of the second pair and the sternal region of the head the space is filled in by the small first pair, which fit closely against the second oostegites behind and are appressed to the maxillipedes above, thus entirely closing the chamber in front, just as the fifth oostegites close it behind.

III. *The Abdominal Region and its Appendages.*

The third region of the body consists of six abdominal segments and a broad triangular caudal plate, the segments being fused together, as already stated and as implied by the generic name.

Viewed dorsally, this area still shows the lines of suture of the various segments, and the central part is distinctly marked off from the lateral, giving an appearance much like that of a trilobite pygidium. The caudal plate is thin and delicate in structure, marked by light and dark bands like those on the abdominal appendages—a similarity which suggests that it may serve (and the oostegites also) as an accessory respiratory organ.

* 'Text-book of Zoology,' Claus-Sedgwick, 1884, p. 457. Other cases might be added; and Milne Edwards, in the original description, refers to the limbs "*carrying at their bases* large foliaceous plates."

The underside of the abdomen I have not been able, in the single specimen in question, to examine in detail. It is, however, possible, by turning back the last pair of oostegites, to see the end of the thoracic sternites, here soft, with a little chitinous matter and a marked conical central papilla (Pl. XIV. fig. 9).

Behind this the thoraco-abdominal suture is evident, and the bases of the *first pair of abdominal appendages* are large and prominent.

The basal joint is bilobed, and bears the large curved plate which we have already noticed as overlapping the dorsal surface of the abdomen above and covering its ventral aspect. Its central region is more strongly calcified than the flexible membranous borders.

The inner angle of the basal segment bears also a true gill-plate lying over (ventral to) those of the succeeding four pairs of appendages, and resembling in form and structure the third lamella of appendages two to five.

The *typical abdominal appendage*, such as is found on segments two to five, has a short basal joint, moderately calcified and imperfectly subdivided, bearing three perfectly distinct lamellæ (Pl. XIV. fig. 10).

On the outside (ventral surface) is a delicate square plate attached to an outer calcification of the basal segment; it is very thin in texture, and the anastomosing blood-vessels are plainly visible.

The middle or largest lamella is triangular in outline, and attached to the main portion of the basal joint: a glance at the dorsal surface shows, however, that it is not attached along the whole of the base, but only at a middle point in a deep sinus, so that its basal margin is markedly cordate.

The third or smallest lamella is less than half the size of the last, of an oval shape, pointed at the distal end, and attached in the proximal region between two unequal forwardly extending lobes; so that it has the same cordate base as the middle lamella, but more irregular.

The third, fourth, and fifth abdominal appendages are all constructed on the type of the second, which I have chosen for description.

The sixth pair, which are so prominent in the larva, still retain the same structure—a basal joint with two flattened lamellæ. In the adult, however, the lamellæ are almost equal in size, narrow in proportion to their length, and devoid of setæ. The

whole appendage seems degenerate, and the tips only are visible between the tail-plate and the lamella of the first abdominal appendage, its function in swimming being apparently taken on by the thoracic limbs.

IV. *The Larval Stage.*

The larvæ found in the brood-chamber seem to be all in about the same stage of development, and all measure about 3 mm. in length.

They possess the subtriangular head of the adult, bearing two large eyes and two pairs of antennæ; but there is no sign of that antero-lateral growth of the first thoracic segment which is so distinctive of the full-grown animal.

The seven thoracic segments show little difference from one another; they bear six pairs of thoracic limbs, each of seven joints, and ending in a strong claw.

In the abdominal region the segments are also at this stage free; but the large caudal plate is already well developed. The last segment bears a pair of limbs, each composed of a basal joint and two oval lamellæ, the outer twice as long as the inner. These and the caudal plate bear strong marginal setæ, and the whole group, no doubt, forms a strong swimming mechanism.

The above statement covers, I believe, all I can say as to the anatomy of *Ourozeuktes*; but as the genus is so little known, it may be useful, for those who will some day have more material to study, to summarize the previous records.

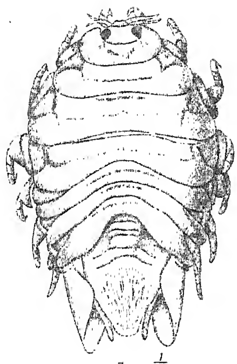
At the commencement I have referred to the establishment of the genus by Milne-Edwards and of its recognition by Gerstaecker. Professor Haswell * mentions a specimen, which he calls provisionally *O. pyriformis*, in the Sydney Museum, and I take this to be the one collected by the 'Novara' Expedition †.

Messrs. Schiödte and Meinert ‡ add two species—the one *O. Monacanthi*, said to be from the "body-cavity" of a *Monacanthus* (one of the Balistidæ) preserved in the Museum at Vienna; the other, *O. caudatus*, a badly preserved specimen taken by Schomburgk near Adelaide, and now in the Berlin Museum.

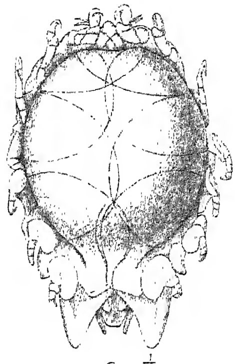
* Haswell, 'Catalogue of Australian Crustacea.' Sydney, 1888.

† Heller, Reise der 'Novara,' Crustacea, p. 148.

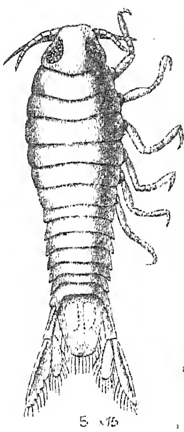
‡ Nat. Tidskrift, vol. xiv. Copenhagen, 1884.



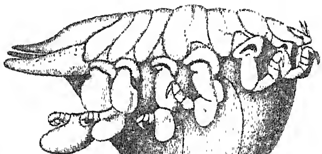
1 $\frac{1}{1}$



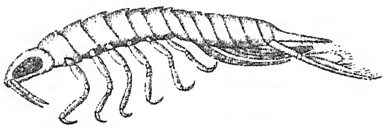
2 $\frac{1}{1}$



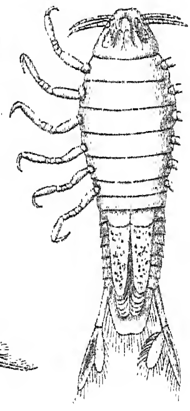
5 ×15



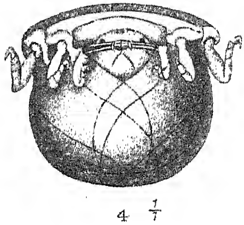
3 $\frac{1}{1}$



6 ×15



7 ×15



4 $\frac{1}{1}$

West, Newman imp.

They also refer to one in the "Museo Godeffroyana" at Hamburg, said to be from Meridional America; but the locality is here doubtful.

To this list I can only add that there are two dried specimens in the British Museum, which show no special characters, and should doubtless be included in the original species. I have been able to examine them through the kindness of Professor Jeffrey Bell.

In this paper I have no intention of discussing the question of species, as I have no pretence to be a student of this particular group. I may say perhaps that Messrs. Schiödte and Meinert's two species differ from the original in little beside their smaller size, which in a Crustacean is not very reliable ground for specific distinction. Also in these cases, as in that of the Sydney Museum, the narrowness of the abdominal region seems, at first sight, a point of importance; but when one considers the greater delicacy of all the posterior portions compared with the strong thoracic rings, one can understand how easily such an appearance may be produced in drying. My own opinion is that the original example was very well preserved as a dried specimen, and that the others only differ in the shrunk condition of their tissues.

The question of species, however, is of less importance than that of the habit of this animal; but unfortunately I have here no further evidence to give.

Probably the nearest living relative of *Ourozeuktes* is the remarkable genus *Ichthyoxenos* described by Herklots *, and more recently (in a paper to which Prof. Howes has kindly called my attention) by Professor Max Weber †. This genus lives entirely in special cavities in the integument of a fish (*Puntius maculatus*, Bleeker) in the rivers of Java. It is less specialized than *Ourozeuktes* in having the abdominal segments free and the first abdominal appendage scarcely modified. Moreover, it has not the thoracic limbs flattened; and this I take as an indication that it is entirely parasitic, whereas the genus now under consideration has the power of living freely, though doubtless parasitic at times.

Taking the larval form into consideration, we may perhaps be

* Herklots, Archives Néerlandaises, V., 1870.

† Weber, 'Separat-Abdruck aus zoologische Ergebnisse einer Reise in Niederländisch Ost-Indien,' Band ii. Leiden, 1892.

justified in regarding *Ourozeuktes* as a descendant of some form similar to *Anilocra*, which has by semi-parasitism become modified, though one can hardly say distinctly degenerate.

EXPLANATION OF THE PLATES.

Plate XIII.

Fig. 1. *Ourozeuktes Owenii*, M.-Edw. Dorsal aspect.
2. ,, ,, Ventral aspect.
3. ,, ,, Lateral aspect.
4. ,, ,, From the front.
5. ,, ,, Larva. Dorsal aspect.
6. ,, ,, ,, Lateral aspect.
7. ,, ,, ,, Ventral aspect.

Plate XIV.

Ourozeuktes Owenii, Milne-Edwards.

[In regard to the details shown on this Plate, it is important to state that the observations were made on a single specimen without removing any of the parts—hence the difficulty of giving an absolutely true representation; but the drawings are the result of repeated examination, and there is no reason to doubt their substantial accuracy.]

Fig. 1. The head and mouth-appendages, seen from below; the latter partly covered by the first pair of oostegites.

Fig. 2. The same, with the first oostegites reflected, showing the maxillipedes.

Fig. 3. The same, with the maxillipedes supposed removed and the second maxillæ reflected back. The styliform first maxillæ are then seen directed forward to the labium, flanked by the mandibles and their palpi.

Figs. 5, 6, 7, 8. The mandibles, first and second maxillæ, and maxillipedes of the left side.

Fig. 9. The abdominal area, seen from the ventral side, with the fifth oostegites reflected and the right first abdominal appendage moved outward.

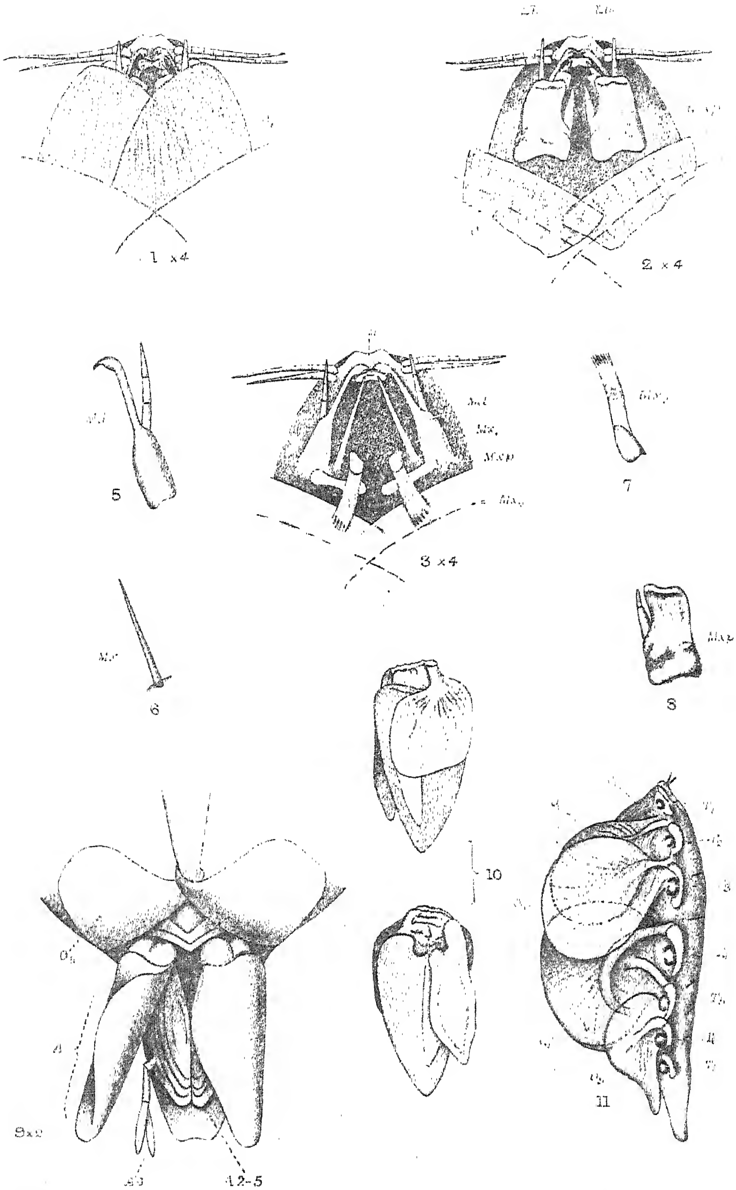
Fig. 10. Second abdominal (respiratory) appendage, seen from the dorsal and ventral aspects.

Fig. 11. Semidiagrammatic side view of the animal, to show the relations of the oostegites to each other and to the limb-sockets.

Reference letters.

M. Mouth.
Lbr. Labrum.
Lb. Bilobed labium.
Md. Mandibles.
Mx_1. First maxillæ.
Mx_2. Second maxillæ.
Mxp. Maxillipedes.

O_1 to O_5. The five pairs of oostegites forming the brood-chamber.
A_1. First abdominal appendage.
A_6. Last abdominal appendage.
A_2 to A_5. Abdominal respiratory appendages.
T_1 to T_7. Sockets of the thoracic appendages.



A.V.J. del.
M.P. Parker lith.
West, Newman imp.

OUROZEUKTES OWENII. *Milne-Edwards.*

On Mimicry in Butterflies of the Genus *Hypolimnas*.

By Colonel Charles Swinhoe, F.L.S., F.Z.S.

[Read 7th November, 1895.]

(Plates XV.–XVII.)

After studying and thinking over the general theory of Protective Mimicry as described in the works of Bates *, Wallace †, Trimen ‡, Fritz Müller §, Meldola ||, Poulton ¶, and others, it occurred to me that the subject would be advanced by the special study of a small group of wide-spread mimetic species throughout the different countries included in its range.

The *Bolina* group of the nymphalid genus *Hypolimnas* or *Diadema* contains, according to systematists, a number of species. When, however, we look at the group from a biological point of view, we find that all these can be merged in two distinct species —*Hypolimnas misippus* (Linn.) and *Hypolimnas bolina* (Linn.). These I selected for my purpose.

It is first of all necessary to gain a conception of the appearance presented by these species before the mimetic form was assumed. This we find to be still retained by the male of *H. misippus*, which is invariably non-mimetic, and that of *H. bolina*, which is non-mimetic in India and in certain other localities which will be mentioned further on. Occasionally the females also revert to the ancestral pattern and resemble the black males. The non-mimetic males are very similar in appearance, while their mimetic females differ widely. A comparison shows that the male of *H. misippus* is smaller than *H. bolina*, and that the large whitish spot on the upperside of each wing is larger, rounder, and bears very little trace of the blue colour which is so conspicuous in *H. bolina*; while the underside has a reddish hue not present in the latter. On the wing, the male of *H. misippus* is a far more active insect; it is a most pugnacious butterfly, perching on the tops of bushes and darting forward to attack any other butterfly that may fly past; but I have found that when crippled and put at liberty

* Trans. Linn. Soc. xxiii. p. 495.

† Ibid. xxv. p. 19.

‡ Ibid. xxvi. p. 497.

§ Proc. Ent. Soc. Lond. 1879, p. 20.

|| Ann. & Mag. Nat. Hist., Dec. 1882.

¶ Proc. Zool. Soc., March 1887.

it speedily falls a prey to the first bird that sees it. In consequence of these fighting propensities the wings often become battered and torn, although apparently without greatly diminishing the activity of the insect. I have removed half the total wing-surface on one side with a pair of scissors, but the powers of flight did not seem to be much impaired. On two occasions, on Cumballa Hill in Bombay, I entirely removed both wings from one side and placed the insect in an exposed situation. On the first occasion one was eaten by a crow, and on the second by a *Mina*; and in neither case did the birds manifest any hesitation in attacking the butterfly. It is fair to conclude from these observations that the species is not distasteful.

The female of *H. misippus* however, except as a very rare variety which resembles the male in appearance, always mimics the commonest of all the *Danainæ*, i. e. *Danais chrysippus* (Linn.), Pl. XV. fig. 2, which is common all over India, Burma, Ceylon, the Malay Archipelago, Madagascar, Aden, and the West, South, and South-eastern coasts of Africa, but apparently not the interior: in all these localities *Hypolimnas misippus* also exists, the female being of the *Danais* colour and pattern (see fig. 1); and where *Danais chrysippus* does not exist, *Hypolimnas misippus* is not to be found *.

In Africa *D. chrysippus* is of a dull bronzy red, and not nearly so brightly coloured as it is in Asia; and similarly the females of *H. misippus* in Africa are dull bronzy red, whereas in Asia they are brightly coloured.

In Africa and at Aden there are several forms of *Danais chrysippus*—some without the white-banded black apical patch to the fore wings (*D. dorippus*, Klug), fig. 4; some possessing this marking, but characterized by white hind wings (*D. alcippus*, Cram.), fig. 6; and also others with the *D. dorippus* pattern and white hind wings. All these forms are mimicked in their several localities by the females of *H. misippus*: compare fig. 4 with 3, and 6 with 5.

In India the form of female *Hypolimnas* which mimics *Danais dorippus* (without the black and white apical patch) is also

* Distant, in Rhop. Malay. p. 168, states:—"This species (*H. misippus*) in its female sex affords one of the best and strongest examples of 'mimicry,' it being a true and startling mimic of *Danais chrysippus*, a protected species which is found with it in its different habitats, excluding America, where, however, it is evidently an introduced species."

found: it is not nearly so frequently met with as the mimic of the true *D. chrysippus*, but it is not uncommon, being occasionally found nearly all over India. So far as I am aware, the particular form of the *chrysippus* group (*D. dorippus*, Klug) which it mimics had never been recorded from India; and it struck me as extraordinary that we should find in India the mimic of a protected insect which is not an inhabitant of the same countries. The two forms of protected insects are exactly alike on the wing; and as no one collects the common *D. chrysippus*, I could not but believe that the explanation of the apparent anomaly lay in the fact that *D. dorippus* had been overlooked. In order to test this conclusion, I engaged two native collectors for three months to catch nothing but *D. chrysippus*. I thus obtained, as may be imagined, many thousands, and the experiment was most successful, because amongst them I obtained no fewer than twelve individuals of *D. dorippus*. This was in Bombay in 1883; in the following year, when in Karachi, in Sind, I obtained three examples, and Major Yerbury sent me two from the Punjab. From the circumstance that the *dorippus* form of *Hypolimnas misippus* is not uncommon, while the same form of the *Danais* is comparatively rare, I am inclined to believe that the latter is dying out in India, and is being replaced by *D. chrysippus*, and that the mimetic form has actually outlasted the form it has mimicked. It must be remembered, however, that the resemblance of the *dorippus* form of the *Hypolimnas* to the typical *Danais chrysippus* is sufficiently striking to afford considerable protection; and hence natural selection would only cause a very gradual return to the other form, on which we must believe that still greater immunity is conferred.

In the species *H. bolina* (Linn.) as we find it in Asia, the female only is mimetic, the male in all localities being of the normal form; in India the female universally mimics the common protected butterfly *Euplœa core* of Cramer. The typical *E. core* does not range very far south, one or two have been taken in Mergui, but there is no record of its more southern extension, its place being taken by other common black *Euplœas* of somewhat similar pattern. We find accordingly that *H. bolina* varies so as to resemble all the common *Euplœas* of the different islands of the Malay Archipelago.

The Amboina form of *H. bolina* mimics *E. climena*, Cram. In Sumatra it is known as *Hypolimnas anomala*, and mimics

Isamia (*Euplœa*) *singapura*, Moore. In Ké Island, under the name of *Hypolimnas polymena* (Pl. XVI. fig. 2), they mimic *Euplœas* with broad whitish borders to the uppersides of the wings (Pl. XVI. fig. 1), a form of pattern common among the *Euplœas* in this island. I have no fewer than three well-defined subgenera of *Euplœas* with such broad white borders from Ké Island—*Calliplœa Hopfferi*, Felder (fig. 1), *Chirosa eurypon*, Hewitson, and *Hirdagra fraterna*, Felder, all possessing well-marked sexual subgeneric distinctive characters.

From the Solomon group I have examples from two islands: in Maleita Island both sexes are mimetic, the male (fig. 3) and female (fig. 5) of the *Hypolimnas* known as *Hypolimnas scopas* respectively mimicking the corresponding sexes of *Euplœa pyrgion* (male fig. 4, female fig. 6). This is a very interesting example, because the differences between the two sexes are fairly distinctive and constant. In another island of this group both sexes (Pl. XVII. fig. 1) mimic *Euplœa polymena* (fig. 2). In this case no local name, so far as I know, has yet been bestowed upon the *Hypolimnas*.

In the Fijis the male of the local unnamed form of *H. bolina* is normal in appearance, but the females occur in many varieties, and seem to exhibit a regular gradation from an appearance like that of the normal male to brown, and from brown to yellow and white, as if the mimetic resemblance was still in a state of transition. In Messrs. Godman and Salvin's fine collection there are upwards of sixty varieties of the female, and on the table are upwards of seventy examples from my own collection showing many varieties; and this is the only instance I have found of any local variation in the mimetic forms of this species. The only two *Euplœas* I have seen from the Fijis are *E. Whitmei* (Butler) and *E. margoensis* (Butler), the first from Lifu Island and the second from Margo. These are dark *Euplœas* and resemble the dark forms of the female *bolina*. But we know very little about the Fijian Lepidoptera, and there may very well be other *Euplœas* corresponding to other forms of the female *Hypolimnas* inhabiting the same locality.

In many of the Southern Islands *H. bolina* in its typical form is found with females mimicking red forms of *Danais*; I have examples from Celebes, Ké Island, Alu, New Britain, and also from North Australia. The Celebes female called *H. nerina*, Felder, is a fair mimic of *Danais chionippe*, Hübn., also found in the same locality; there are probably other similar forms of

red *Danais* in these islands. The mimic is here much larger than the mimicked. This is the only case I know of, in which this species of *Hypolimnas* mimics a red insect and thus gains itself a considerable patch of this colour.

Next we turn to Africa, and we invariably find that both sexes of what we may fairly call the African forms of *Hypolimnas bolina* mimic various species of *Danainæ*, the normal form of the male having entirely disappeared. Hence, from the systematist's point of view, the specific characters having been lost in both sexes, they bear as many specific names as there are local forms mimicking the accompanying species of *Danais*.

In quest of these mimetic forms, I searched through Mr. Crowley's magnificent collection of African butterflies at Croydon, where I found very many examples, from which I selected three. In every locality where the forms occur, the mimicry seems to be remarkably perfect, but there are local peculiarities in the patterns of both mimic and mimicked in many places. The localities are as widely separated as Natal in the South-east, and the Cameroons in the West of Africa.

From Natal, I have obtained *Hypolimnas marginalis* (Pl. XVII. fig. 3), which mimics *Amauris dominicanus* (fig. 4). From Grahamstown, *H. mina* mimicking *A. echeria*; from the Cameroons, *H. dubia* (fig. 5) mimicking *A. egialea* (fig. 6).

Conclusions.

Having thus brought together all the facts I have come across and those which have been previously published, it remains to ascertain their bearing upon the theory of mimicry, for this theory has never been subjected to the evidence derived from the systematic study of a small group of wide-ranging, mimetic insects, carefully traced through all the localities included in their range. This has, however, been done for the *Papilio merope* group, so admirably worked out by Roland Trimen (Trans. Linn. Soc. xxvi. p. 497, and South-African Butterflies, vol. iii. 1889, pp. 243–55), but the total range of these butterflies is far more limited and the number of different forms much smaller than is the case with the *Hypolimnas* group.

Bearing upon general Theory of Mimicry.

In the first place, we find the strongest support to the general theory of mimicry as originally suggested by H. W. Bates. The

varied changes which occur are explained by this theory, and by no other yet propounded. When we trace *Hypolimnas bolina* from India into Amboina, Sumatra, Ké Island, two islands of the Solomon group, Fiji, Celebes, and various part of Africa, we meet with a different form in each locality, a form which from the biological standpoint may be called the *Hypolimnas bolina* of the locality. That local changes should occur may be intelligible in many theories, but that they should invariably be in the direction of a superficial resemblance to one butterfly (or in some cases two or more distantly related butterflies) out of the numerous and varied Rhopalocerous fauna of each locality, and that one a specially defended species, well known and avoided by insect-eating animals, is only to be explained by the theory of mimicry,—by the advantages conferred by relatively greater resemblance having acted as a selective test during all the stages of development. The theory of mimicry has received much support by the investigations which have been carried on since Bates propounded it in 1862, but I believe that no evidence is so complete and convincing as that supplied by the genus *Hypolimnas*.

Bearing upon the special liability of female to mimetic resemblances.

The facts also bear in an interesting manner upon the details as well as upon the general theory. Thus the observation that females are more liable to be defended by mimicry than males, and its explanation (suggested by A. R. Wallace), as due to their "slower flight when laden with eggs, and their exposure to attack while in the act of depositing their eggs upon the leaves," receives further support and confirmation. Among the numerous forms of both the *misippus* and *bolina* group, we meet with no case in which the male is mimetic while the female is non-mimetic: the male of *misippus* is peculiarly active on the wing, and being able to defend itself in this way, is never mimetic; the male of the less active *bolina* affords a beautiful transition from the condition met with in *misippus* to a mimicry as complete as that of the female. In this respect the group is far more interesting than that of *P. merope*, in which the males are never mimetic.

The ancestral non-mimetic form from which the mimetic varieties have been derived: various phases of development of mimicry.

The ancestral form of both groups is preserved in the closely similar non-mimetic males, and the rare cases of reversion to the same type exhibited by the females. But the beautiful evidence supplied by the existence of the ancestral non-mimetic form of both sexes in certain islands is wanting here, although so well seen in the *merope* group.

The most ancestral form described in this paper is probably the Fijian *bolina*, in which the females exhibit a transition from non-mimetic to mimetic forms; then would follow the Indian *bolina*, in which the female is not a very perfect mimic of *Euplœa core*, and still retains traces of the blue spots so characteristic of the non-mimetic males, culminating in the Celebes form, in which the mimicry of the female is fairly complete and has entailed a more marked divergence from the normal type than any other form in this group: at this stage *misippus* must be placed, with its non-mimetic male and females with extremely perfect and detailed mimicry. We finally reach the climax of change in those island forms of *bolina* in which the males also are mimetic, and in Africa, where no more ancestral phase is at present known.

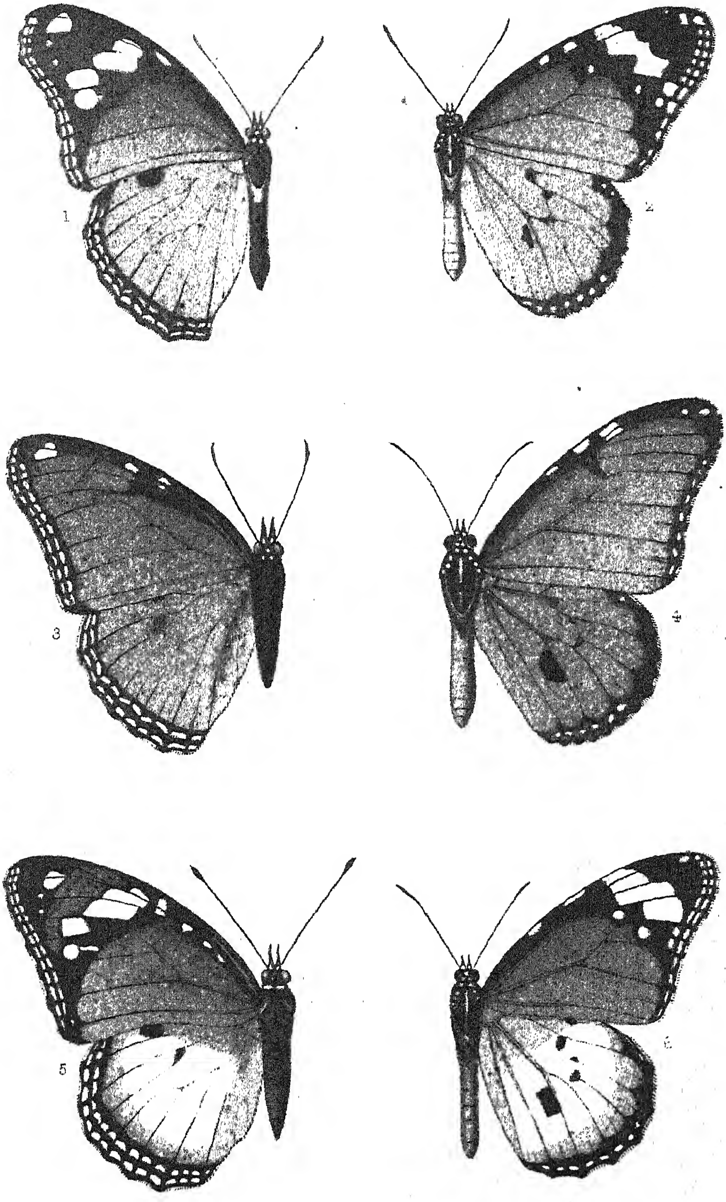
Bearing upon mimetic resemblance to different species in one locality.

The well-known mimetic resemblance to two or more very differently coloured species of distasteful insects in the same locality is not well exemplified, although it appears probable that some varieties of the females from Fiji bear this interpretation, which may also in part explain the occurrence of all three varieties of the female *misippus* at Aden, where the three corresponding forms of *Danais* are also found (viz. *chrysippus*, *alcippus*, and *dorippus*). But here, too, we meet with nothing that approaches the condition of some species of the *merope* group of the S.-African *Papilio cenea* for example, in which four forms of the female respectively mimic such differently coloured species as *Danais chrysippus*, *Amauris dominicanus*, and two varieties of *Amauris echeria*, thus widening the area of possible mistake so far that the mimetic species can become comparatively numerous without the risk of extermination.

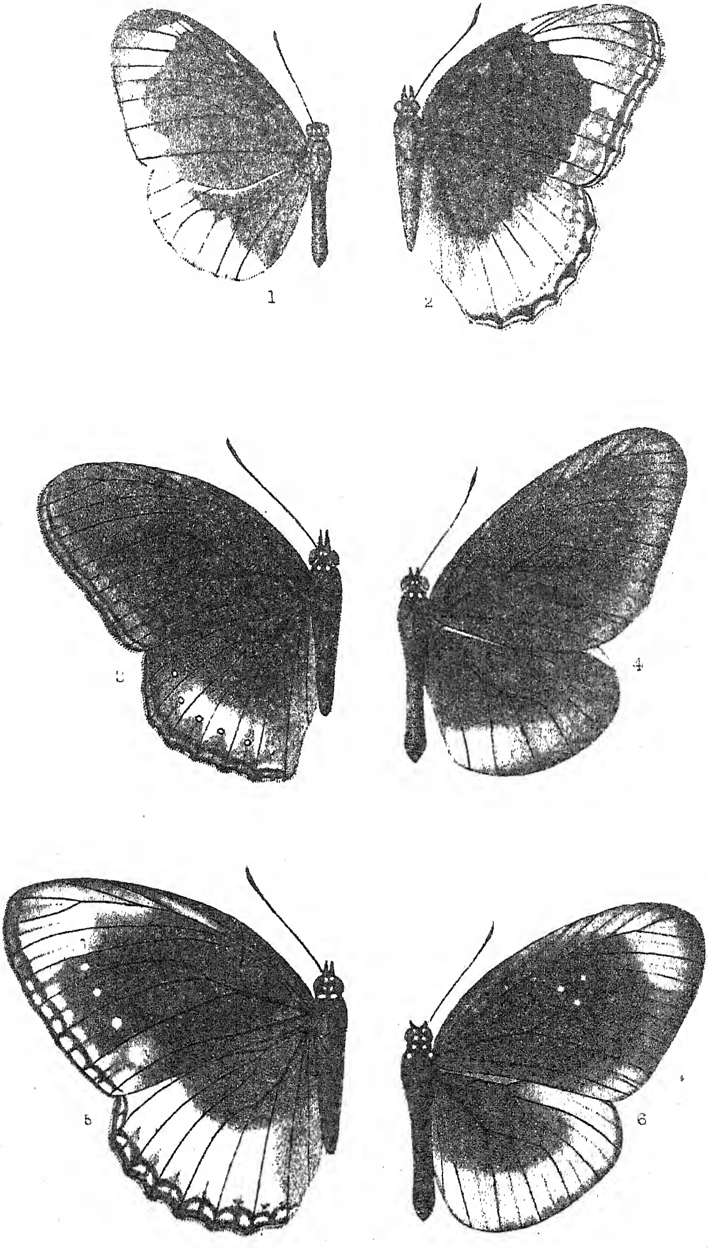
Different conditions under which mimicry may appear: attempted explanation.

Finally our facts have an instructive bearing upon the very different conditions under which mimicry may appear in the most closely related species. It seems clear that we have to do with two species which are unable to exist without this deceptive resemblance to some specially protected form, either in both sexes or in the one which is chiefly exposed to attack. Wherever we find these butterflies, whatever changes they may undergo, the resemblance which enables them to live upon the reputation of some local distasteful species is maintained. Mimicry being equally necessary to both *misippus* and *bolina* in order to ward off extermination, we nevertheless find that it pursued an utterly different course in these two species. *Hypolimnas misippus* has attached itself to a single well-known, conspicuous, wide-ranging species of distasteful butterfly, resembling it with great fidelity, and following it through the details of even minor changes. In order to achieve this result, it has been compelled to depart very widely from the ancestral form—even more so than is the case with any of the *bolina* group. But this extreme variation in one direction appears to have deprived it of the power of developing variations in other directions; so that its existence and range seem to depend upon the existence and range of a single butterfly, *Danais chrysippus* and its varieties. In *Hypolimnas bolina*, on the other hand, we meet with much greater elasticity: its range is almost unlimited as regards the conditions imposed by mimicry, for it can vary in each locality into the semblance of some local species.

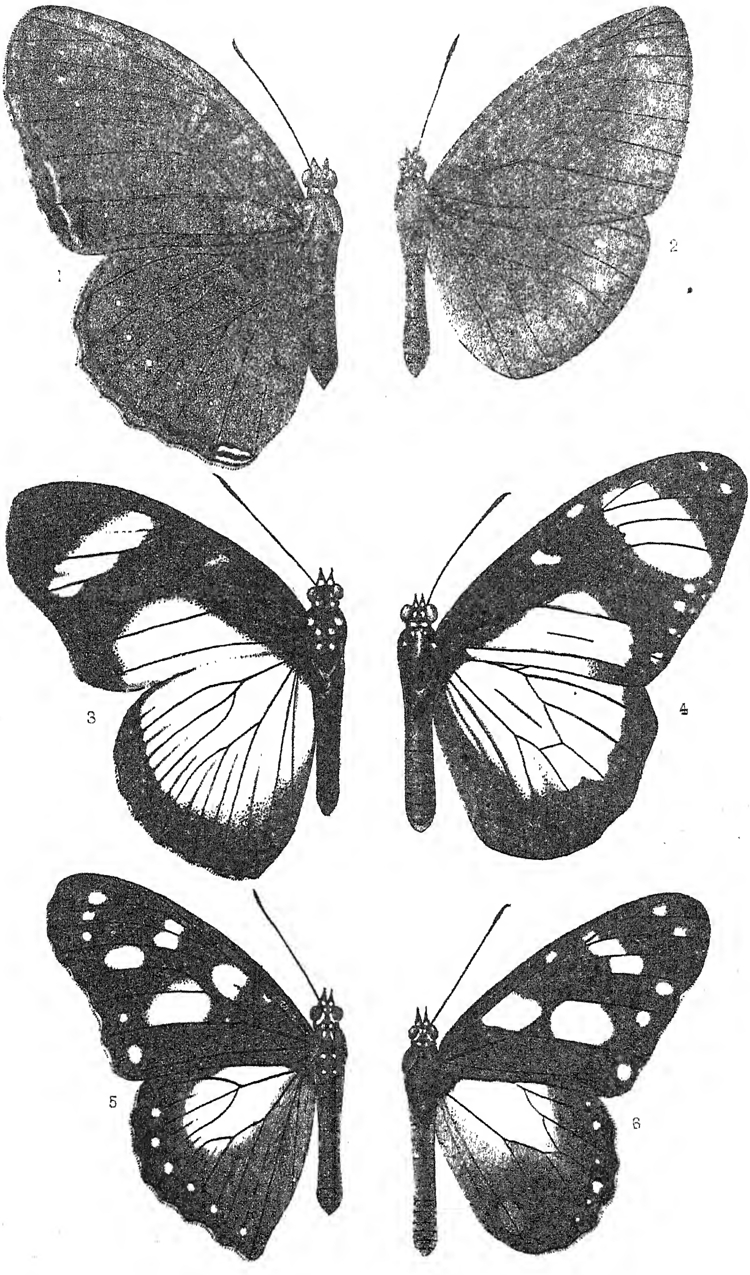
How is this wide divergence to be explained? Many biologists would be inclined to lay stress on the amount and kind of individual variation which has been at the disposal of the selective process during the development of the mimetic resemblance; and it is certain that the results must have been largely influenced by this. It is noteworthy that *bolina* includes forms which are both older and younger than those of *misippus*, the latter representing but a single one out of the many phases of departure from the ancestral type represented by the former. It may be that this comparatively narrow limitation of *misippus* is merely due to the exclusive predominance of a single specially advantageous resemblance, *Danais chrysippus* being so abundant and well-known in the localities where it occurs, and its distribution affording scope for a wide range. Or variation may have carried



F. C. Knight del. et lith. West, Newman chromo.



E.C. Knight del. et lith. West, Newman imp.



E.C.Knight del.et lith.

West, Newman imp.

misippus in this direction from the very first, and sufficient protection being thus conferred there would be no tendency towards the production of other forms. In either case we must look upon the selective process as chiefly responsible for the result. It is impossible to deny abundant powers of variation to *misippus,* when we remember its faithful resemblance to the special changes undergone by *D. chrysippus.* But variation being under the guidance of selection in one direction only, has produced nothing in any other direction. It is easy to imagine conditions under which *H. bolina* might become equally restricted If *Euplœa core* had the distribution of *Danais chrysippus*, it is probable that no other mimetic variety would have been produced. Or if *Danais chionippe* of Celebes had the range and abundance of *D. chrysippus*, it is probable that the superior advantages attending the resemblance to it might cause the ultimate predominance of this one out of the many mimetic forms of *H. bolina.*

If, then, we are right in believing that the results are determined by the range and abundance of the mimicked form, because this, through selection, determines the number and kind of the mimicking varieties, it is clear that selection rather than unguided variation is the essential cause of the phenomena, always assuming the necessary amount of variation for selection to act upon.

The fact that selection follows, where possible, the path of least resistance as regards variation, is well seen in *H. bolina.* Not one of its many mimetic forms departs so widely from the ancestral appearance as those of *misippus,* and for the production of most of them comparatively small changes are necessary. In India and Malaya, with a single exception, various dark-coloured *Euplœas* are mimicked. The interesting exception of the *chianippe* form proves that much greater divergence is possible, and that the path provided by the easiest and most probable variation is only followed when it is advantageous. When we pass into Africa, we find that the place of the genus *Euplœa* is taken by the *Danais* genus *Amauris*, and dark-coloured butterflies of this specially protected genus have afforded ready models for mimicry, so that here too the necessary conditions have been met by less divergence than has been necessary for *H. misippus.*

My thanks are due to Messrs. Godman, Salvin, and Crowley for examples of various mimetic forms, and especially to Professor Poulton for much kindly assistance in deducing the above conclusions.

EXPLANATION OF THE PLATES.

PLATE XV.

Figs. 1, 3, 5. *Hypolimnas misippus*, ♀ (3 forms).
Fig. 2. *Danais chrysippus*.
4. „ *dorippus*.
6. „ *alcippus*.

PLATE XVI.

Fig. 1. *Euplœa Hopfferi*.
4. „ *pyrgion*, ♂.
6. „ „ ♀.

Fig. 2. *Hypolimnas polymena*.
3. „ *scopas*, ♂.
5. „ „ ♀.

PLATE XVII.

Fig. 2. *Euplœa polymena*.
4. *Amauris dominicanus*.
6. „ *egialea*.

Fig. 1. *Hypolimnas*, sp.
3. „ *marginalis*.
5. „ *dubia*.

An Account of the Butterflies of the Genus *Charaxes* in the Collection of the British Museum. By Arthur G. Butler, Ph.D., &c., Senior Assistant-Keeper, Zoological Department.

[Read 7th November, 1895.]

One of the first genera which I ever studied, and the first which I monographed, was the genus *Charaxes*, a paper on which I published in 1865 in the ‘Proceedings of the Zoological Society,’ in which I recorded sixty-eight species (two of which, however, were noted as doubtful and were subsequently suppressed): the present paper enumerates no fewer than one hundred and fifty-nine.

I have followed Prof. Aurivillius in uniting *Palla* to *Charaxes*: if kept separate, it would have to be broken up into several genera, and *Charaxes* itself would in like manner have to be subdivided; this, indeed, has been done for the Indian species by Mr. Moore; but apart from outline of wing I have been unable to discover any constant structural characters on which to base these genera. That wing-outline in *Charaxes* is not of generic importance seems clear, from the fact that (i.) in many of the species it differs to an extraordinary degree in the sexes; (ii.) the most nearly related species (as, for instance, *C. Balfouri* and *C. varanes*) differ in this respect as much as any of the proposed new genera; and, lastly, (iii.) it is not uniform, even when apparently so to a casual observer, the shortening or absence of the hind-wing tails occurring abruptly in a single species in the middle of a group.

When I last arranged *Charaxes*, about the year 1892, our series occupied a single cabinet of 20 drawers; last year, however, Messrs. Salvin and Godman (with their usual liberality)

presented the whole of their fine series of *Charaxes* to the Trustees, including the specimens formerly representing the collections of Messrs. Bates and Druce—thus enriching our already fine collection with numerous types and with specimens of many species new to us.

With such rich material, it has been possible to form a much more just estimate of the value of characters formerly held to have a specific value than could otherwise have been formed; the result being that, in some instances, described types have had to be sunk to the rank of seasonal or varietal phases, whilst in a few cases the evident constancy of certain characteristics in long series has shown that what have hitherto been regarded as varieties have some claim to be considered distinct.

The collection as it now stands fills three cabinets or sixty cabinet-drawers, and as nearly every African collection which has arrived lately has added to the species of this genus, it seems probable that another ten years will necessitate a further extension. The incorporation of the specimens in the collection of the late Mr. Hewitson will not greatly enrich the general series, so many of his specimens being without localities, that it will be necessary to treat these as duplicates; all of them are, however, recorded in the present paper.

Of the 159 described forms which I have permitted to stand as species, 142 are represented in the Museum; but as several of those included in the larger number may prove upon examination to be merely individual variations of well-known forms, it would be premature to assume that seventeen described species remained to be acquired by us.

C. odysseus may be the female of *C. lactetinctus*, and it is even possible that the differences which separate *C. Everetti* and *Staudingeri* from *C. Durnfordi* may prove not to be constant to locality. How it is that Drury's *C. eudoxus* has never reached us from the time when it was figured is indeed a puzzle; it is hardly possible that it can have been a made-up insect, for no two known species could be so fitted together as to produce it.

I now proceed to enumerate the whole of the species of *Charaxes* at present described, together with descriptions of several not previously recorded and a complete catalogue of the whole of the specimens in the Museum collection—those from the Salvin and Godman collection being referred to as "from S. & G. coll."

1. C. JASON GROUP.

1. CHARAXES BRUTUS.

Papilio brutus, *Cramer, Pap. Exot.* iii. pl. ccxli. figs. E, F (1782).
Papilio cajus, *Herbst, Natursyst. Schmett.* iv. pl. lxiv. figs. 1, 2 (1790).

a. Natal (*Bates coll.*), ♂; from the Salvin & Godman collection.
b. S. Africa, ♀.
c. Delagoa Bay (*Monteiro*), ♀; from S. & G. coll.
d. Slopes of Kilima-njaro (*Hannington*), ♂.
e. Zomba (*Macclounie*), ♂.
f. Taita, E. Africa (*J. A. Wray*), ♂.
g. Croboe Distr., Accra (*Higlett*), ♂.
h. Accra (*E. T. Carter*), ♀.
i, j. Victoria, Cameroons (*Druce coll.*), ♂, ♀; from S. & G. coll.
k. Sierra Leone (*Dr. Preuss*), ♂; from S. & G. coll.
l. Sierra Leone (*Foxcroft*), ♀.
m. Gold Coast, ♂.
n. Winnebar, W. Africa (*C. R. Williams*), ♂; from S. & G. coll.

Var. with unusually broad band across primaries.
o. Accra (*Higlett*), ♀.

Var. with unusually narrow band across primaries.
p. West Africa, ♂.
q. Angola (*Monteiro, Druce coll.*), ♀; from S. & G. coll.
r. W. Africa, ♀.

Hewitson coll.
s. Natal, ♂.
t. Without locality, ♂.
u. Old Calabar, ♀.
v. Without locality, ♀.

The South-African specimens have the band on the primaries more sinuous, wider at the back and narrower in front than in the West Coast examples; on the under surface also the discal outer bordering of the white belt is dull brick-red, like the centre of the submarginal spots, whereas in the Western form it is ochreous; examples from Delagoa Bay and East Africa are

intermediate in character and completely link the two local races.

2. Charaxes andara.

Charaxes andara, *Ward, Ent. Month Mag.* ix. p. 209 (1873); *Mabille, in Grand. Mad.* p. 187, pl. xxii. figs. 4–6 (1887).

a. Antananarivo (*Rev. R. Toy*), ♂.
b, c. Fort Dauphin (*M. J. Cloisel*), ♀ ♀.

Hewitson coll.

d–f. Without locality, ♂ ♂.
g. Without locality; confounded with *C. cacuthis*, ♀.

3. Charaxes Druceanus.

Charaxes Druceanus, *Butler, Cist. Ent.* i. p. 4, n. 1 (1869); *Lep. Exot.* pl. 10. fig. 4 (1870); *Westwood, Thes. Oxon.* p. 182, pl. 34. fig. 6 (1874).
Charaxes cinadon, *Hewitson, Ent. Month. Mag.* vi. p. 177 (1870).

a. Old Calabar (*Bates coll.*), ♂; from S. & G. coll.
Type, *b*. Old Calabar (*Druce coll.*), ♂; from S. & G. coll.
c. Gaboon (*Druce coll.*), ♂; from S. & G. coll.
d. Zomba (*Macclounie*), ♀.
e. Orange River (*Druce coll.*), ♂; from S. & G. coll.
f. Kaffraria (*Druce coll.*), ♂; from S. & G. coll.
g. Nyika, Nyasa-land (*R. Crawshay*), ♂.

Hewitson coll.

h. Without locality (probably type of *C. cinadon*), ♂.
i. Orange River, ♂.

4. Charaxes andranodorus.

Charaxes andranodorus, *Mabille, Bull. Soc. Ent. Belg.* 1884, p. 184; *Grand. Mad.* p. 182, pl. xxi. figs. 1 & 1 *a*, pl. xxv. *a*. figs. 1 & 1 *a* (1887).
Var. ♂. Charaxes zoippus, *Mabille, Bull. Soc. Ent. Belg.* 1884, p. 185; *Grand. Mad.* p. 179, pl. xxv. figs 2 & 2 *a* (1887).

a, b. Fianarantsoa (*Deans Cowan*), ♂, ♀.
c. Ankafana, Betsileo (*Deans Cowan*), ♀.
d. Madagascar (*Druce coll.*), ♀; from S. & G. coll.

Hewitson coll.

e. Without locality, labelled *Druceanus*, ♂.

The male described as *C. zoippus* differs so slightly from that sex of typical *C. andranodorus*, that I can only regard it as a sport.

5. Charaxes phraortes.

Charaxes phraortes, *Doubleday, Proc. Zool. Soc.* 1847, p. 60; *Butler, Lep. Exot.* pl. x. fig. 6 (1870); *Grand. Mad.* p. 177, pl. xxv. figs. 1 & 1 *a* (1886).

Type, *a*. Madagascar (*Dr. Lyall*), ♀.

This species must be very local, for the type still appears to be unique.

6. Charaxes phœbus.

Charaxes phœbus, *Butler, Proc. Zool. Soc.* 1865, p. 625, pl. xxxvi. fig. 2.

Types, *a*, *b*. Abyssinia (*Sir W. C. Harris' Expedition to Shoa*), ♂, ♀.

7. Charaxes eudoxus.

Papilio eudoxus, *Fabricius, Ent. Syst.* iii. 1, p. 65, n. 203 (1793); *Drury, Ill.* iii. pl. xxxiii. figs. 1, 2.

"Sierra Leone."

This species is evidently intermediate between *C. phœbus* and *C. pollux*, the under surface more nearly resembling the former and the upper surface the latter species.

If *C. eudoxus* actually came from Sierra Leone, it is a most remarkable fact that none of the collections recently received from that locality have contained it, and that, up to the present time, Drury's figures are all that remain to show us what this species is like.

8. Charaxes pollux.

Papilio pollux, *Cramer, Pap. Exot.* i. pl. xxxvii. figs. D, E (1776).
Papilio camulus, *Drury, Ill.* iii. pl. xxx. figs. 1, 2 (1782).

a, *b*. Sierra Leone (*Barchard*), ♂ ♂.
c. Sierra Leone (*P. Crowley*), ♀.
d, *e*. Sierra Leone (*coll. Druce*), ♂; from S. & G. coll.
f. Sierra Leone (*coll. Bates*), ♂; from S. & G. coll.
g, *h*. Sierra Leone (*Dr. Preuss*), ♂ ♂; from S. & G. coll.
i. Sierra Leone (*coll. Druce*), ♂.
j. Angola (*Monteiro*), ♂; from S. & G. coll.
k. Monbuttu (*Emin Pasha*), ♂.
l. Zomba (*Macclounie*), ♂.

Hewitson coll.

m–*o*. Sierra Leone, ♂.
p, *q*. Sierra Leone, ♀.

9. CHARAXES HANSALII.

Charaxes Hansalii, *Felder, Reise der Nov., Lep.* iii. p. 446, n. 728, pl. 59. figs. 3, 4 (1867).

a. Abyssinia (*coll. Kaden*), ♂; from S. & G. coll.

Hewitson coll.

b. Bogos, ♀.

This very rare species has been confounded with the yellow-banded form of *C. castor*, to which I have given the name of *C. flavifasciatus*. Through the carelessness of Fabricius, *C. castor* and *C. pollux* have been transposed: in my monograph (P. Z. S. 1865) I supposed the Fabrician names to have priority and therefore followed his lead; Kirby put the synonymy right, but left the species in the wrong places.

10. CHARAXES CASTOR.

Papilio castor, *Cramer, Pap. Exot.* i. pl. xxxvii. figs. E, F (1776).
Papilio pollux, *Fabricius, Ent. Syst.* iii. 1, p. 63, n. 197 (1793).
Var. Charaxes flavifasciatus, *Butler, Proc. Zool. Soc.* 1895, p. 251.

Var. *flavifasciatus*.

a, b. Delagoa Bay (*Monteiro*), ♂, ♀; from S. & G. coll.
c. Zambesi (*Bates coll.*), ♀; from S. & G. coll.
d. Upper Egypt, ♂.
e, f. Central Africa (*Emin Pasha*), ♂ ♂.
g. Zomba (*Macclounie*), ♂.
h. Accra (*E. T. Carter*).

Hewitson coll.

i, j. Delagoa Bay, ♂, ♀.

C. castor typical.

k. Sierra Leone (*Dr. Preuss*), ♂; from S. & G. coll.
l. Sierra Leone (*Barchard*), ♀.
m. Old Calabar (*Bates coll.*), ♂; from S. & G. coll.
n. Old Calabar (*White*), ♂; from S. & G. coll.
o. Cameroons, ♂; from S. & G. coll.
p. Angola (*Monteiro*), ♂; from S. & G. coll.
q. Ashanti, ♂.
r. Sierra Leone (*Foxcroft*), ♀.
s, t. Lake Tanganyika (*C. Hore*), ♂ ♂.
u. Mamboia, E. Africa (*Dr. Kirk*), ♂; from S. & G. coll.

Hewitson coll.

v. Sierra Leone, ♂.

w, x. Fernando Po, ♀ ♀.

The pale-banded form is the commoner type in the East, and the orange-banded form in the West. It is probable that they represent two races, the ranges of which overlap: in such cases it seems to me imperative that both forms should have names. As we have not received *C. flavifasciatus* (in any instance) with the typical form, it is possible that they do not actually occur together.

11. Charaxes saturnus.

♂. Charaxes saturnus, *Butler, Proc. Zool. Soc.* 1865, p. 624, pl. xxxvi. fig. 1; ♀, *Lep. Exot.* i. p. 5, pl. ii. fig. 2 (1869).

Charaxes pelias (part), *Trimen, Rhop. Afr. Austr.* i. p. 175 (1862).

a. Congo, ♂ *.

b. West Africa, ♀; from S. & G. coll.

c. Angola (*Monteiro*), ♂; from S. & G. coll.

d. Angola (*Rogers*), ♀; from S. & G. coll.

e. Lake Tanganyika (*C. Hore*), ♂ †.

f. Zomba (*Macclounie*), ♂.

g, h. Taita, E. Africa (*J. A. Wray*), ♂, ♀.

i. Damara-land (*Bates coll.*); from S. & G. coll.

j, k. Matabele (*Selous*), ♂; from S. & G. coll.

Type, *l.* Zambesi (*H. Walter*), ♂.

m. Delagoa Bay (*Monteiro*), ♂.

n. Delagoa Bay (*Monteiro*), ♂; from S. & G. coll.

o. Durban (*G. E. Shelley*), ♂; from S. & G. coll.

Hewitson coll. (as *C. pelias*).

p. Delagoa Bay, ♂.

q, r. Angola, ♂ ♂.

s, t. Congo, ♂, ♀.

Var. *laticinctus.*

Charaxes saturnus, var. laticinctus, *Butler, P. Z. S.* 1895, p. 251.

Type, *u.* Sulim bin Najimb, Konde (*R. Crawshay*), ♂.

v. Zomba (*Macclounie*), ♀.

w. Shiré River (*Bates coll.*), ♂; from S. & G. coll.

* Examples from the Congo and Angola are larger than elsewhere and have the blue spots on the hind wings better developed.

† Also a second imperfect male from Niomkolo.

This form approaches *C. jason*; indeed, excepting for the well-defined tawny band which crosses the upper surface of the wings, it more nearly approaches that species than it does *C. pelias*.

12. Charaxes pelias.

Papilio pelias, *Cramer, Pap. Exot.* i. pl. iii. figs. C, D (1775).
Charaxes pelias, *Butler, Lep. Exot.* i. pl. x. fig. 5 (1870).

a, b. Locality not recorded (*Druce coll.*), ♂, ♀; from S. & G. coll.

As is well known, this species, which is still extremely rare in collections, appears to be confined to South Africa.

13. Charaxes jason.

Papilio jason, *Linnæus, Syst. Nat.* i. 2, p. 749 (1767); *Drury, Ill. Exot. Ent.* i. pl. 1. fig. 1 (1773).
Papilio jasius, *Fabricius, Syst. Ent.* p. 449 (1775).
Papilio rhea, *Hübner, Eur. Schmett.* i. figs. 111, 112 (1794).
Eribœa unedonis, *Hübner, Verz.* p. 47 (1816).

a. Corsica (*Col. Yerbury*), ♂.
b. Spain (*Bates coll.*), ♀; from S. & G. coll.
c–e. Central Europe (*Druce coll.*), ♂ ♂; from S. & G. coll.
f. S. France (*Bates coll.*), ♂; from S. & G. coll.
g–i. Europe (*Zeller coll.*), ♂ ♂.
j–l. Europe, ♀, ♂ ♂.

Hewitson coll.

m–p. Without locality, ♂, ♀ ♀.

14. Charaxes epijasius.

Charaxes epijasius, *Reiche in Ferr. Gal. Voy. Abyss., Ent.* p. 469, pl. 32. figs. 1, 2 (1849).

a. White Nile (*Petherick*), ♂.
b, c. Abyssinia, Atbara, ♂ ♂.
d, e. Senegal, ♂ ♂.
f. Senegal (*coll. Kaden*), ♂; from S. & G. coll.
g. Lower Niger (*W. A. Forbes*), ♂; from S. & G. coll.

Hewitson coll.

h–j. Without locality, ♂ ♂, ♀.

2. C. FABIUS GROUP.

15. CHARAXES ACHÆMENES.

Charaxes achæmenes, *Felder, Reise der Nov., Lep.* iii. p. 446, pl. 59. figs. 6, 7 (1867).

Charaxes jocaste, *Boisduval MS., Butler, P. Z. S.* 1865, p. 628; *Trans. Ent. Soc.* 1869, p. 274.

a, *b*. Senegal, ♂, ♀.
c–e. Abyssinia (*Druce coll.*), ♂ ♂, ♀; from S. & G. coll.
f–h. Abyssinia, Atbara, ♀ ♀, ♂.
i. Kandera (*Emin Pasha*), ♂.
j. Zomba (*A. Whyte*), ♂.
k, *l*. Delagoa Bay, ♂, ♀.
m. Delagoa Bay (*Monteiro*), ♀; from S. & G. coll.
n, *o*. Zambesi (*Bates coll.*), ♀, ♂; from S. & G. coll.

Hewitson coll.

p–t. Delagoa Bay, ♂ ♂, ♀ ♀.

16. CHARAXES FABIUS.

Papilio fabius, *Fabricius, Spec. Ins.* ii. p. 12 (1781).
Papilio solon, *Fabricius, Ent. Syst.* iii. 1, p. 69 (1793).
Papilio euphanes, *Esper, Ausl. Schmett.* pl. 59. fig. 1 (1785–90).

Burmese race, with markings above brimstone-yellow.

a. Thoungyeen Valley, Tenasserim (*Capt. Chas. Bingham*).
b, *c*. Tilin Yaw, Burma (*E. Y. Watson*).

Typical race.

d. Mhow (*Col. Swinhoe*), ♂.
e. Bombay (*Hunter*), ♀.
f. Bombay, ♂; from S. & G. coll.
g. Poona (*Col. Swinhoe*), ♀.
h. Neilgherries (*Col. Swinhoe*), ♂.
i. Madras (*E. Y. Watson*), ♂.
j, *k*. Madras (*Vigors coll.*), ♀, ♂.
l, *m*. Ceylon (*Col. Yerbury*), ♂ ♂.
n. Ceylon (*Whyte*), ♂; from S. & G. coll.

17. CHARAXES LAMPEDO.

♀. Eribœa lampedo, *Hübner, Samml. exot. Schmett.* ii. pl. 52. figs. 3, 4.

♂. Charaxes zephyrus, *Butler, Cist. Ent.* i. p. 5 (1869); *Lep. Exot.* i. pl. x. fig. 1 (1870).

Type, *a*. Without locality (*coll. Druce*), ♂; from S. & G. coll.
b. Palawan, Philippines (*Dr. Platen*), ♂; from S. & G. coll.
c. Without locality (*coll. Kaden*), ♀; from S. & G. coll.

18. Charaxes echo.

Charaxes echo, *Butler, Ann. & Mag. Nat. Hist.* ser. 3, vol. xx. p. 401, pl. viii. figs. 5, 6 (1867).

a. West coast of Borneo, ♂.
b. Labuan, Borneo (*Low*), ♂; from S. & G. coll.

Hewitson coll. (as *C. lampedo*).

c. Borneo, ♂.
d. Sarawak (*Wallace*), ♂.

19. Charaxes hannibal.

Charaxes hannibal, *Butler, Lep. Exot.* i. p. 14, pl. vi. fig. 5 (1869).

Hewitson coll. (as *C. lampedo*).

Type, *a*. Tondano, Celebes (*Wallace*), ♀.
b. Macassar, ♀.

This species seems to be closely allied to *C. echo*, and it is just possible that it may prove to be the female of that species; but hitherto I have seen no females of *C. echo* from Borneo, and therefore am unable to say whether the differences which exist are merely sexual or local.

3. C. orilus Group.

20. Charaxes orilus.

Charaxes orilus, *Butler, Lep. Exot.* i. p. 13, pl. v. fig. 5 (1869).

Hewitson coll.

Type, *a*. Timor (*Wallace*), ♂.

The following is one of the most interesting groups in the genus, the greater number of the males being so similar that they are confounded in most collections under the names of *C. ephyra* or *C. ethalion*; many of the females, however, are widely different.

Another point of interest is that in some of the species there are both blue-banded and white-banded females; these are probably seasonal forms.

Owing to the slight differences which characterize some of the males, it is not surprising to find that they have not been referred to their proper females; but, on the other hand, it is singular that even careful Lepidopterists have agreed in regarding two distinct females as sexes in more than one instance.

4. C. ETHEOCLES GROUP.

21. CHARAXES GUDERIANA.

♂. Nymphalis Guderiana, *Dewitz, Nova Acta Akad. Naturf. Halle*, 1879, p. 200, pl. ii. fig. 18.

♀. Charaxes Guderiana, *Butler, Proc. Zool. Soc.* 1893, p. 648; *Trimen, Proc. Zool. Soc.* 1894, p. 42, pl. v. fig. 8.

a–c. Lake Mweru (*R. Crawshay*), ♂ ♂.
d. Fwambo (*A. Carson*), ♀.
e. British E. Africa (*Dr. Gregory*), ♂.
f–h. Zomba (*A. Whyte*), ♀, ♂ ♂.
i. Zomba (*A. Sharpe*), ♂.

Hewitson coll. (as *C. alladinis* ♂).
j. Nyasa, ♂.

22. CHARAXES KIRKII.

♀. Charaxes Kirkii, *Butler, Ent. Month. Mag.* xviii. p. 105 (1881).
♂. Charaxes Kirkii, *Butler, Proc. Zool. Soc.* 1888, p. 60.

a. Foda (*Emin Pasha*), ♂.
Type, *b.* Mamboia (*Dr. Kirk*), ♀.
c. Kandera (*Emin Pasha*), ♂.
d, e. Abyssinia (*Druce coll.*), ♂ ♂; from S. & G. coll.

Hewitson coll. (as *C. alladinis* ♂).
f. White Nile, ♂.

This is the nearest ally of *C. Guderiana*, which it approaches in both sexes. In the male the discoidal and two following subcostal spots on the primaries are lilacine and small, and, as a rule, only two of the submarginal series exist, even these are small with lilac edges; very rarely one or two extra white points occur; the marginal spots also are bluish grey or bronze-greenish, not white; on the secondaries the blue band is either wholly wanting, or represented by two or three separate greenish lunules, and in the marginal lunules green takes the place of white and the red central streaks upon them become more or less pronounced. The female is in some respects nearer to that sex of *C. viola*,

and the form of the tawny band across the primaries agrees with that of the white band of *C. etheocles*.

23. CHARAXES VIOLA.

♀. Charaxes viola, *Butler, Proc. Zool. Soc.* 1865, p. 627, pl. xxxvi. fig. 4.

♀ (as ♂). Charaxes chiron, *Staudinger, Exot. Schmett.* p. 168, pl. lviii. (1866).

a. Old Calabar (*White*), ♂; from S. & G. coll.
b. West Africa, ♀.
c. Angola (*Rogers*), ♂; from S. & G. coll.
d, e. Ashanti, ♂ ♂.
f. Croboe District, Accra (*Higlett*), ♂.

Hewitson coll. (as *C. ephyra* ♂).

g. Angola, ♂.

The male of *C. viola* nearly resembles that of *C. Kirkii*, but has a greener tint above and a redder tint below; the two subapical spots on the upper surface of the primaries are wanting, and the marginal spots are metallic green; the red streaks on the marginal lunules of the secondaries are almost or altogether obliterated. Staudinger's so-called male from Senegal is unquestionably a female; how he failed to recognize its identity with this insect figured by me in 1865 I do not understand.

24. CHARAXES ETHEOCLES.

♀. Papilio etheocles, *Cramer, Pap. Exot.* ii. pl. cxix. figs. D, E (1779).
♂. Papilio ephyra, *Godart, Enc. Méth.* ix. p. 355, no. 18 (1823).

a. Ondo country, Lagos (*Sir G. Carter*), ♂; from S. & G. coll.
b. Cape Coast, W. Africa (*F. Niblett*), ♀.
c. Barombi, Cameroons (*Druce coll.*), ♂; from S. & G. coll.
d. Stanley Pool, Congo River (*H. H. Johnston*), ♂; from G. & S. coll.

The male on the upper surface much resembles that sex of *C. viola*, but the marginal spots of the primaries are smaller and less diffused, the white submarginal spots of the secondaries are also smaller. On the under surface the differences are more pronounced, the whole basal area being more or less suffused with white, and the lunate spots towards outer margin much darker and well-defined. M. Godart's description is sufficiently good to identify the species with certainty.

25. Charaxes rosæ.

♀. Charaxes rosæ, *Butler, Proc. Zool. Soc.* 1895, p. 255.
Charaxes phæus ♀, *Hewitson, Ent. Month. Mag.* vol. xiv. p. 82 (1877); *Trimen, South Afr. Butt.* i. p. 344 (1887).
Var. ? Charaxes alladinis ♀, *Dewitz, Nova Acta Akad. Naturf. Halle,* vol. 50. no. 4, pl. xvii. fig. 9 (1887).

Types, *a, b.* Delagoa Bay, ♂ ♀.
c, d. Delagoa Bay (*Monteiro*), ♂, ♀; from S. & G. coll.
e. Zomba, ♂ (*Macclounie*).
f. Lake Tanganyika (*C. Hore*), ♂.

Hewitson coll.
g, h. Delagoa Bay (*Monteiro*), ♀ ♀.

The male is a shorter and broader insect than that sex of any of the preceding species: the primaries are less falcate, with the outer margin much less inarched; these wings on the upper surface are immaculate, but the secondaries show precisely the same markings on the outer border as the female; the under surface is glossed precisely as in the female, and sometimes shows well-marked indications of the whitish characters of that sex. The only species with which it might be confounded, if carelessly examined, is *C. ethalion*; but it is much more sericeous on the under surface, and its geographical distribution would assist in showing to which female of the white-banded species it belonged.

26. Charaxes manica.

♀. Charaxes manica, *Trimen, Proc. Zool. Soc.* 1894, p. 43, pl. vi. fig. 9.
Var. ? Charaxes ephyra ♀, *Dewitz, Nova Acta Akad. Naturf. Halle,* vol. 50. no. 4, pl. xvii. fig. 11 (1887).

? *a.* Atbara, Abyssinia, ♂.

I am very doubtful about our male, and think it much more probable that the insect figured by Dewitz (*loc. cit.* fig. 10) is the true male of this species, and our example that sex of *C. Dewitzi.*

27. Charaxes phæus.

♀. Charaxes phæus ♂, *Hewitson, Ent. Month. Mag.* vol. xiv. p. 82 (1877); *Trimen, South Afr. Butt.* i. p. 344 (1887).
♂. Charaxes alladinis, *Butler in Proc. Zool. Soc.* 1893, p. 648.

a. Ngama's, Kakoma (*R. Crawshay*), ♂.
b. Zomba (*A. Whyte*), ♂.
c. Delagoa Bay, ♀.
d. Delagoa Bay (*Monteiro*), ♀; from S. & G. coll.

Hewitson coll.

Type, *e.* Delagoa Bay (*Monteiro*), ♀.

The form of the male is exactly that of the female, and the two subapical spots on the primaries are very characteristic of the species; the secondaries are like those of Dewitz's male *C. ephyra*, excepting that the red marginal markings are strongly defined; below, male and female are almost absolutely alike.

28. CHARAXES CEDREATIS.

♀ ♀ (as sexes). Charaxes cedreatis, *Hewitson, Ent. Month. Mag.* x. p. 247 (1874); *Exot. Butt.* v. *Char.* pl. v. figs. 22–24 (1876).

♂ ♀. Charaxes Carteri, *Butler, Ent. Month. Mag.* xviii. p. 108 (1881).

Types, *a, b.* Accra (*E. T. Carter*), ♂, ♀.
c. Croboe District, Accra (*Hickling*), ♂.
d. Ashanti, ♂.
e. West Africa, ♀.

Hewitson coll.

Type, *f.* Without locality, ♀; (type of Hewitson's male).
g, h. Fernando Po, ♀ ♀.

The male has much the character of *C. viola* ♂ on the upper surface, but the under-surface colouring is of a greyish-olive colour, precisely like that of the female: most of the pale borders to the lines also appear as in that sex, and especially the irregular whitish patch running to the abdominal margin above the anal angle.

29. CHARAXES ALLADINIS.

♀. Charaxes alladinis, *Butler, Cist. Ent.* i. p. 5 (1869); *Lep. Exot.* i. pl. 10. fig. 2 (1870).

a. Ondo Country, Lagos (*Sir G. Carter*), ♂; from S. & G. coll.

Type, *b.* Locality not known (*Druce coll.*), ♀; from S. & G. coll.
c. West Africa, ♂.
d. Barombi, Cameroons (*Dr. Preuss*), ♂; from S. & G. coll.
e. Gaboon (*Bates coll.*), ♂; from S. & G. coll.

Hewitson coll.

f. Without locality, ♀.

With the sexes of this species before one there is no possibility of doubting their identity, the rosy flush over the whole under surface being very characteristic. Above, the male has the basal two-fifths of the primaries bronze-green, the costal border is also of the same colour; at equal distances between the cell and apex are three pale green spots nearly equidistant, and along the outer margin a series upon bronze-green nebulæ; the secondaries show scarcely a trace of red on the greenish marginal spots, the submarginal white spots are sharply defined, and within is a superciliary lunulate bronze-green streak (somewhat as in *C. phæus* ♂, but nearer to outer margin).

30. Charaxes Hollandi.

♂, ♀. Charaxes Hollandi, *Butler, Ann. & Mag. Nat. Hist.* 6th ser. vol. xii. p. 266 (1893).

Types, *a–d.* Sierra Leone (*Barchard*), ♂ ♂, ♀.

e, f. Sierra Leone (*Dr. Preuss*), ♂, ♀; from S. & G. coll.

g, h. Sierra Leone (*P. Crowley*), ♂ ♂.

Hewitson coll.

i. Without locality, ♀.

Seasonal form.—The male more nearly resembling that sex of *C. etheocles* on the upper surface; the female with the unbroken part of the transverse band white shaded with silvery blue.

j, k. Sierra Leone (*Dr. Preuss*), ♂, ♀; from S. & G. coll.

Local form.—The male larger, with less defined markings towards costa of primaries and outer margin of secondaries; the female like the preceding form, but with the spots on the primaries white instead of buff, and the band across the secondaries wider.

l, m. Old Calabar (*J. W. Cockburn*), ♂ ♀.

31. Charaxes ethalion.

♀. Charaxes ethalion, *Boisduval, Voy. de Deleg.* ii. p. 593 (1847).

Nymphalis erithalion, *Westwood & Hewitson, Gen. Diurn. Lep.* pl. 48. fig. 1 (1850).

Var. Charaxes Baumanni, *Rogenhofer, Verhandl. z.-b. Ges. Wien,* xli. p. 564 (1891).

Local form, C. Dewitzi, *Butler, P. Z. S.* 1895, p. 255.

♀. Charaxes alladinis ♂, *Dewitz, Nova Acta Akad. Naturf. Halle,* vol. 50. no. 4, pl. xvii. fig. 8 (1887).

Hewitson coll.

a, b. Delagoa Bay (*Monteiro*), ♂, ♀.

Excepting that the marginal green and red markings on the secondaries are rather better developed, the male corresponds with that of the typical form.

Seasonal form of var. *Dewitzi.*—The male has lost the red marginal streaks on the secondaries, and the female has the band white partly bordered with silvery blue, nearly as in that sex of the typical form.

c. Zomba (*Macclounie*), ♂.
d. Delagoa Bay, ♀.

Typical *C. ethalion.*

e, f. Kaffraria (*Druce coll.*), ♂, ♀; from S. & G. coll.
g. Durban (*G. E. Shelley*), ♀; from S. & G. coll.
h. Natal (*Bates coll.*), ♂; from S. & G. coll.
i, j. Natal (*Plant*), ♂, ♀.
k. Natal (*Gueinzius*), ♂.
l. Zulu country (*Angas*), ♀.

Hewitson coll. (as *C. ephyra*).

m–o. Natal, ♂, ♀ ♀.
p, q. Without locality, ♂, ♀.

Staudinger gives a poor figure of the male under the name of *C. ephyra*, a species from which there is not the least difficulty in distinguishing it.

I can make nothing more of *C. Baumanni* than a dwarfed female answering to our specimen from Zulu (*l, supra*).

32. Charaxes Hildebrandti.

Charaxes Hildebrandti, *Dewitz, Acta Ac. Nat. Cur.* xli. 2, p. 200, pl. ii. fig. 16 (1879).

Charaxes talagugæ, *Holland, Trans. Am. Ent. Soc.* xiii. p. 330, pl. viii. fig. 2 (1886).

a. Ondo country, Lagos (*Sir G. Carter*), ♂; from S. & G. coll.

This is an extraordinarily distinct and very beautiful species.

33. Charaxes Whytei.

♂. Charaxes Whytei, *Butler, Proc. Zool. Soc.* 1893, p. 649, pl. lx. fig. 2; ♀, 1895, p. 255.

♂. Charaxes Selousi, *Trimen, Proc. Zool. Soc.* 1894, p. 45, pl. vi. fig. 10.

a, b. Zomba (*A. Whyte*), ♂ ♂.
c, d. Zomba (*Macclounie*), ♀ ♀.
e, f. Zomba (*Consul A. Sharpe*), ♂, ♀.

Since writing this paper, I have discovered that *C. Thysii* should be referred to this section of the genus.

5. C. ANTICLEA GROUP.

34. CHARAXES ANTICLEA.

Papilio anticlea, *Drury, Ill. Ex. Ent.* iii. pl. xxvii. figs. 5, 6 (1782).
Papilio horatius, *Fabricius, Ent. Syst.* iii. 1, p. 64 (1793).

a. Sierra Leone (*Foxcroft*), ♂.
b. Sierra Leone (*Rev. D. F. Morgan*), ♀.
c. Sierra Leone (*Stathard coll.*), ♂.
d. Without locality (*coll. Kaden*); from S. & G. coll.

Hewitson coll.

e. Without locality, ♂.
f. Angola, ♂.

Seasonal form. (Orange deeper, ocelli more numerous.)

g. Sierra Leone (*Druce coll.*); from S. & G. coll.

Hewitson coll.

h, i. Angola, ♂ ♂.

35. CHARAXES PROTOCLEA.

Charaxes protoclea, *Feisthamel, Ann. Soc. Ent. France,* 1850, p. 260.

a, b. Barombi, Cameroons (*Dr. Preuss*), ♂, ♀; from S. & G. coll.
c–g. Cameroons, ♂ ♂, ♀; from S. & G. coll.
h, i. Victoria, Cameroons (*Druce coll.*), ♂ ♂; from S. & G. coll.
j, k. Cameroons, ♂, ♀.
l. Old Calabar (*White*), ♂; from S. & G coll.
m. Old Calabar (*Druce coll.*), ♀; from S. & G. coll.
n. Ashanti, ♂.
o. Without locality (*coll. Kaden*), ♀; from S. & G. coll.
p, q. Sierra Leone (*Dr. Preuss*), ♀, ♂; from S. & G. coll.

Hewitson coll.

r. Old Calabar, ♂.
s. Cameroons, ♂.
t. Without locality, ♀.

36. CHARAXES AZOTA.

♀. Philognoma azota, *Hewitson, Entom. Month. Mag.* vol. xiv. p. 82 (1877).

♂. Charaxes azota, *Butler, Ann. & Mag. Nat. Hist.* ser. 6, vol. xv. p. 249 (1895).

Type, Delagoa Bay (*Monteiro*), ♂.

Local form: *Charaxes calliclea*, H. Grose Smith, Ann. & Mag. Nat. Hist. ser. 6, vol. iii. p. 130 (1889).

Mombasa.

Not in the British Museum collection, but intermediate in character between typical *C. azota* and the following:—

Local form: *Charaxes nyasana*, Butler, Ann. & Mag. Nat. Hist. ser. 6, vol. xv. p. 249 (1895).

Charaxes azota ♂, *Hewitson, Entom. Month. Mag.* vol. xiv. p. 181 (1878).

a. Zomba (*Macclounie*), ♂.

Hewitson coll.

b. Nyasa-land (*Thelwall*), ♂.

Now that I have seen Mr. Grose Smith's examples of his *C. calliclea* from Mombasa, I can no longer regard this form as more than a local race of *C. azota*, the differences in *C. calliclea* being such as partly to connect the two extremes. In all probability a series collected over the whole of Eastern Africa would supply all the links from one type to the other, but I do not doubt that the form of Delagoa Bay is constantly dissimilar from that of Nyasa-land, and therefore that distinctive names, by which these local races may be indicated, are a positive gain to the student.

6. C. LUCRETIUS GROUP.

37. CHARAXES LACTETINCTUS.

♂. Charaxes lactetinctus, *Karsch, Ent. Nachr.* xviii. p. 113 (1892); *Berl. ent. Zeit.* xxxviii. p. 190, Taf. v. fig. 3 (1893).

Adeli.

Probably allied to *C. lucretius*, to judge from the under surface; above, it is more like *C. candiope*, but with the basal area bluish white, more after the fashion of *C. varanes*.

38. Charaxes odysseus.

♀. Charaxes odysseus, *Staudinger, Deutsche ent. Zeit., Lep.* v. p. 260 (1892).

Island of St. Thomas, West Africa.

Said to be most like *C. etesipe* ♀ on the upper surface, but *C. lucretius* on the under surface. It is not in the Museum collection.

39. Charaxes lucretius.

Papilio lucretius, *Cramer, Pap. Exot.* i. pl. lxxxii. figs. E, F (1779).

a, b. Sierra Leone (*Barchard*), ♂, ♀.
c. West Africa, ♂; from S. & G. coll.
d, e. Isubu, ♂, ♀.
f. Cameroons, ♂; from S. & G. coll.
g. Monbuttu (*Emin Pasha*), ♀.
h–j. Old Calabar, ♂ ♂; from S. & G. coll.
k. Old Calabar (*White*), ♂; from S. & G. coll.
l–n. Fernando Po, ♀ ♀, ♂; from S. & G. coll.
o. Ashanti, ♂.
p. Croboe District, Accra (*Higlett*), ♂

Hewitson coll.
q–s. Fernando Po, ♂, ♀ ♀.
t. Old Calabar, ♂.
u. Angola, ♂.

40. Charaxes cynthia.

♂. Charaxes cynthia, *Butler, Proc. Zool. Soc.* 1865, p. 626, pl. xxxvi. fig. 3.

♀. Charaxes lysianassa, *Westwood, Thes. Oxon.* p. 181, pl. xxxiv. figs. 3, 4 (1874).

a. Old Calabar (*J. W. Cockburn*), ♂.
b. Old Calabar (*White*), ♀; from S. & G. coll.
c. West Africa, ♀.
d. Rio del Rey (*H. H. Johnston*), ♂.
e. Locality unrecorded (*Coll. Kaden*), ♂; from S. & G. coll.
Types, *f, g.* Ashanti, ♂ ♂.
h. Victoria, Cameroons (*Druce coll.*), ♂; from S. & G. coll.

Hewitson coll.
i. Angola, ♀.

41. Charaxes Macclounii.

Charaxes Macclounii, *Butler, Proc. Zool. Soc.* 1895, p. 252, ♂, pl. xv. fig. 1.

a–d. Zomba (*Macclounie*), ♂ ♂, ♀ ♀.

42. Charaxes Lasti.

Charaxes Lasti, *H. Grose Smith, Ann. & Mag. Nat. Hist.* ser. 6, vol. iii. p. 131 (1889); ♂. *Rhop. Exot.* p. 8, pl. *Char.* iv. figs. 4, 5 (1890); ♀. *Trimen, Proc. Zool. Soc.* 1894, p. 39, pl. v. fig. 6.

Mombasa, Pungwe Valley and Pungwe River.

a, b. Zomba, ♂ ♂ (*Consul A. Sharpe*).

43. Charaxes Boueti.

Charaxes Boueti, *Feisthamel, Ann. Soc. Ent. France,* 1850, p. 261.

Gambia.

From the description, this species would seem to be nearly allied to *C. candiope*, and I should have considered it merely a form of that species, only Mr. Feisthamel has omitted to mention the green veins on the under surface, which are especially characteristic of the *C. candiope* group. If a very distiuct species, one would have supposed that it must have been received and recognized since 1850; nevertheless, from a drawing of the type shown to me by Mr. Aurivillius after I had completed this paper, I find that *C. Boueti* is nearly allied to *C. Lasti.*

7. C. candiope Group.

44. Charaxes candiope.

Nymphalis candiope, *Godart, Enc. Méth.* ix. p. 353 (1819).

Charaxes viridicostatus, *Aurivillius, Œfv. Akad. Förh.* xxxvi. (n. 7), p. 41 (1879).

a. Nguru Hills, E. Africa, ♂; from S. & G. coll.
b. Summit of Mt. Höhnel (*Dr. Gregory*), ♀.
c. Delagoa Bay (*Monteiro*), ♂; from S. & G. coll.
d, e. Kaffraria (*Druce coll.*), ♂ ♂; from S. & G. coll.
f. Durban (*G. E. Shelley*), ♀; from S. & G. coll.
g, h. Natal (*Gueinzius*), ♀, ♂.
i. Natal (*Plant*), ♂.
j. Congo (*Richardson*), ♂ var.
k. Angola (*Monteiro*), ♂; from S. & G. coll.
l–n. Sierra Leone (*Barchard*), ♂ ♂.
o. Sierra Leone (*Dr. Preuss*); from S. & G. coll.

Var. = probably typical *viridicostatus*.
p. Taita, E. Africa (*J. A. Wray*), ♂.
q. Zomba (*Macclounie*), ♀.

Hewitson coll.
r, *s*. Natal, ♂ ♂.
Var. *t*. Delagoa Bay, ♂.
u. Angola, ♀.

Local race?: *C. thomasius*, Staudinger, Exot. Schmett. p. 169 (1886).

Island of St. Thomas.

Staudinger describes the pattern as somewhat similar to that of *C. Cowani* (my description of which he has evidently overlooked, inasmuch as he describes it as a new species).

45. Charaxes antamboulou.

Charaxes antamboulou, *Lucas, Ann. Sci. Nat.* vol. xv. p. 1 (1872).

♂ as ♀. Charaxes antamboulou, *Mabille, in Grand. Mad.* p. 191, pl. 23. figs. 3, 4, var. (1885).

*Var. *a*, *b*. Madagascar, Fort Dauphin (*M. J. Cloisel*), ♂ ♂.
Typical, *c*. Ankafana, Betsileo (*Rev. Deans Cowan*), ♀.

Hewitson coll. (as *C. candiope*).
d, *e*. Madagascar, ♂ ♂.

The sexes of this species, as of the allied *C. candiope*, are alike on both surfaces, but the under surface varies considerably, as in the Continental species. Hewitson's two males and one female correspond exactly on both surfaces.

46. Charaxes Cowani.

♂. Charaxes Cowani, *Butler, Ann. & Mag. Nat. Hist.* ser. 5, vol. ii. p. 285 (1878); ♀, *ibid.* vol. v. p. 336 (1880).

♂. Charaxes antamboulou, *Mabille* (part.), *in Grand. Mad.* p. 191, pl. 23. figs. 1, 2 (1885).

Type, *a*. Fianarantsoa (*Rev. Deans Cowan*), ♂.
b. Fianarantsoa (*Rev. Deans Cowan*), ♀.
c–e. Betsileo (*Rev. Deans Cowan*), ♂ ♂; from S. & G. coll.
f. Madagascar, ♂.

The female has a curious general resemblance to *C. antamboulou* on the upper surface, but the external area is blacker and

* Corresponding with Mabille's figure of the supposed female, but primaries more falcate.

the apex of the primaries acuminate as in the male; on the under surface the pattern of the sexes closely corresponds and exhibits little variation. I do not know what to make of Mabille's second figure, but suspect it to be taken from a male of *C. antamboulou*.

47. CHARAXES ANALAVA.

Charaxes analava, *Ward, Ent. Month. Mag.* ix. p. 3 (1872); *Mabille, in Grand. Mad.* p. 194, pl. xxv. figs. 2, 2 *a* (1887).

a. Antananarivo (*Kingdon*), ♂.
b–c. Madagascar (*Druce coll.*), ♀, ♂; from S. & G. coll.

Hewitson coll.

d–g. Madagascar, ♂ ♂.

8. C. ZOOLINA GROUP.

48. CHARAXES BETANIMENA.

Charaxes betanimena, *Lucas, Ann. Sci. Nat.* vol. xv. art. 22, p. 3 (1872).
Charaxes andriba, *Ward, Entom. Month. Mag.* ix. p. 210 (1873).
♀. Nymphalis Freyi, *Brancsik, Jahresb. Ver. Trencsin*, 1891, pl. 7.

a. Fort Dauphin (*M. J. Cloisel*), ♂.

Herr Brancsik's figure is evidently made from an imperfect or distorted specimen.

49. CHARAXES NEANTHES.

Nymphalis neanthes, *Hewitson, Exot. Butt.* i. *Nymph.* pl. i. figs. 2, 3 (1854).

a, b. Kaffraria (*Druce coll.*), ♂ ♂; from S. & G. coll.
c. Natal (*Bates coll.*), ♀; from S. & G. coll.
d, e. Natal (*Gueinzius*), ♀, ♂.
f. Natal (*Plant*), ♂.
g–i. Delagoa Bay (*Monteiro*), ♂ ♂, ♀; from S. & G. coll.
j. Lake Mweru (*R. Crawshay*), ♂.
k, l. Cameroons, ♀, ♂.

Hewitson coll.

m. Natal, ♂.
n–q. Without locality, ♂, ♀ ♀.
r. Delagoa Bay, ♀.

50. CHARAXES EHMCKEI.

Charaxes Ehmckei, *Dewitz, Berl. ent. Zeit., Lep.* xxvi. p. 382, pl. vii. fig. 4 (1882).

Hewitson coll. (as *C. betanimena*).

a–c. Angola, ♂ ♂.

In colouring this species is intermediate between the *C. neanthes* and *C. zoolina* series: it is, however, remarkable on account of the development, in the male, of the tail at the extremity of the third median branch. I do not doubt that this species is one of the links connecting *Palla* with *Charaxes*, the upper-surface coloration of *C. Ehmckii* being very like that of *P. varanes*.

51. Charaxes Homeyeri.

Charaxes Homeyeri, *Dewitz, Berl. ent. Zeit.* xxvi. p. 382, pl. vii. fig. 3 (1882).

Angola.

Not in the Museum collection.

52. Charaxes Kahldeni.

Charaxes Kahldeni, *Dewitz, Berl. ent. Zeit.* xxvi. p. 381, pl. vii. figs. 1, 2 (1882).

Angola.

53. Charaxes zoolina.

Nymphalis zoolina, *Doubleday & Hewitson, Gen. Diurn. Lep.* pl. 53. fig. 1 (1850).

a, b. Cameroons, ♂, ♀.
c. Mamboia (*Dr. Kirk*), ♀.
d. Nguru Hills, E. Africa, ♂; from S. & G. coll.
e. Slopes of Kilima-njaro (*Hannington*), ♂.
f. Victoria Nyanza (*Hannington*), ♂.
g, h. Delagoa Bay (*Monteiro*), ♂, ♀; from S. & G. coll.
i–k. Natal (*Bates coll.*), ♂, ♀ ♀; from S. & G. coll.
l. Natal (*Gueinzius*), ♀.
m, n. Natal (*Plant*), ♀ ♀.

Hewitson coll.

o–r. Delagoa Bay, ♂ ♂, ♀ ♀.
s. Natal, ♀.
t. Zambesi, ♂.

54. Charaxes betsimiseraka.

Charaxes betsimiseraka, *Lucas, Ann. Sci. Nat.* vol. xv. art. 22, p. 2 (1872); *Mabille in Grand. Mad.* p. 195, pl. xxi. figs. 2, 2 *a* (1887).

Not in the British Museum collection.

55. Charaxes relatus.

Charaxes relatus, *Butler, Ann. & Mag. Nat. Hist.* ser. 5, vol. v. p. 394 (1880).

a, b. Fort Dauphin (*M. J. Cloisel*), ♂, ♀.

Hewitson coll.

Type, *c.* Madagascar, ♂.

I believe, when perfect, the male of this species has a single tail like the nearly allied *C betsimiseraka*; both of the males in the Museum are probably mutilated.

56. Charaxes nobilis.

Charaxes nobilis, *Druce, Entom. Month. Mag.* x. p. 13 (1873).

Charaxes agabo, *Distant, Proc. Zool. Soc.* 1879, p. 708, pl. liv. fig. 4.

Charaxes homerus, *Staudinger, Deutsche ent. Zeit., Lep.* p. 132, pl. ii. fig. 1 (1891).

Type, *a.* Old Calabar (*coll. Druce*); from S. & G. coll.

This grand species evidently belongs to the *C. zoolina* group.

9. C. jahlusa Group.

57. Charaxes jahlusa.

Nymphalis jahlusa, *Trimen, Rhop. Afr. Austr.* i. p. 177 (1862), ii. p. 341, pl. iii. fig. 5 (1866).

a, b. Cape of Good Hope (*Layard*), ♂ ♂; from S. & G. coll.
c. S. Africa (*Sir Andrew Smith*), ♀.
d. Natal (*Bates coll.*), ♂; from S. & G. coll.
e. Natal (*Druce coll.*), ♂; from S. & G. coll.

Hewitson coll.

f, g. Cape of Good Hope, ♂ ♂.

This is easily separable from *C. argynnides* by its paler ground-tint, less blackened apex and outer border, and the slightly less prominently sigmoidal outer margin to the primaries.

58. Charaxes argynnides.

Charaxes argynnides, *Westwood, Proc. Ent. Soc.* ser. 3, vol. ii. p. 10 (1864).

a. Lake Nyasa (*Cotterell*), ♂; from S. & G. coll.
b. Shire River (*Bates coll.*), ♀; from S. & G. coll.
c, d. Lake Tanganyika (*C. Hore*), ♂ ♂.

Hewitson coll. (as *C. jahlusa*).

e, f. Zambesi, ♂, ♀.
g. Nyasa, ♂.

Both this species and *C. jahlusa* have two types of marking on the under surface—the one type having the apical area of primaries and the whole of the secondaries with a whitish ground to the markings, the other with a brownish argillaceous ground: these differences are probably seasonal.

10. C. NICHETES GROUP.

59. CHARAXES LEONINUS.

Charaxes leoninus, *Butler, Proc. Zool. Soc.* 1895, p. 253, pl. xv. fig. 2.

a, b. Zomba (*Macclounie*), ♂, ♀.
c–e. Zomba (*Consul A. Sharpe*), ♂, ♀ ♀.

60. CHARAXES NICHETES.

Charaxes nichetes, *H. Grose Smith, Ent. Month. Mag.* xx. p. 58 (1883); *Rhop. Exot.* i. *Char.* pl. iv. figs. 1–3 (1890).

Charaxes hamatus, *Dewitz, Ent. Nachr.* x. p. 285 (1884); *Nova Acta Leop.-Carol. Akad. Naturf.* vol. 50. no. 4, pl. xvii. fig. 12 (1887).

Charaxes ogovensis, *Holland, Trans. Am. Ent. Soc.* xiii. p. 330, pl. viii. fig. 2 (1886).

Type, *a.* Cameroons, ♂; from S. & G. coll.

11. C. LAODICE GROUP.

61. CHARAXES ZELICA.

Charaxes zelica, *Butler, Ent. Month. Mag.* vi. p. 28 (1869); *Lep. Exot.* i. p. 12, pl. v. fig. 3 (1869).

Type, *a.* Ashanti ?, ♂.

62. CHARAXES PORTHOS.

Charaxes porthos, *H. Grose Smith, Ent. Month. Mag.* xx. p. 57 (1883); *Rhop. Exot.* i. *Char.* pl. i. figs. 4, 5 (1887).

Charaxes midas, *Staudinger, Deutsche ent. Zeit., Lep.* p. 135, pl. ii. fig. 4 (1891).

a. Old Calabar, ♂; from S. & G. coll.
b. West Africa, ♂; from S. & G. coll.

63. CHARAXES MYCERINA.

Nymphalis mycerina, *Godart, Enc. Méth.* ix. p. 369 (1823); *Lucas, Lep. Exot.* pl. 65. fig. 2 (1835).

a. Old Calabar (*Swan*), ♂; from S. & G. coll.
b. Old Calabar (*White*), ♂; from S. & G. coll.
c. Without locality, ♀; from S. & G. coll.
d, e. Cameroons, ♂ ♂; from S. & G. coll.

f, g. Cameroons, ♂ ♂.
h. Victoria, Cameroons (*Druce coll.*), ♂; from S. & G. coll.
i. Barombi, Cameroons (*Dr. Preuss*), ♂; from S. & G. coll.
j, k. Sierra Leone (*Dr. Preuss*), ♂ ♂; from S. & G. coll.
l. Sierra Leone (*Barchard*), ♂.

Hewitson coll.

m, n. Cameroons, ♂, ♀.
o. Fernando Po, ♂.

64. CHARAXES NAUSICAA.

Charaxes nausicaa, *Staudinger, Deutsche ent. Zeit., Lep.* p. 137 (1891).

a. Old Calabar (*J. W. Cockburn*), ♂.
b. "R. Ogowai" (? Ogooawai, Soudan), ♂.

This insect is so extremely close to *C. mycerina*, that it would not be at all surprising to find that it was an occasional sport of that species; it is almost too rare for a seasonal form. The chief differences are in the outline of the wings, the primaries having the costal margin less arched, the secondaries having the outer margin regularly dentate-sinuate: the pattern and colouring on both surfaces are nearly the same as in *C. mycerina*; but on the under surface the darker bandings are less clearly defined.

65. CHARAXES LAODICE.

♀. Papilio laodice, *Drury, Ill. Exot. Ent.* iii. pl. 26. figs. 1, 2 (1782).

Papilio lycurgus, *Fabricius, Ent. Syst.* iii. 1, p. 67 (1793).

♂. Nymphalis nesiope, *Hewitson, Exot. Butt.* i. *Nymph.* pl. i. figs. 5, 6 (1854).

a. Old Calabar (*Bates coll.*), ♂; from S. & G. coll.
b. Old Calabar (*Druce coll.*), ♂; from S. & G. coll.
c. Old Calabar (*J. W. Cockburn*), ♂.
d. Barombi, Cameroons (*Dr. Preuss*), ♂; from S. & G. coll.
e, f. Isubu, ♂ ♂.
g. Fernando Po, ♂; from S. & G. coll.
h. Lake Tanganyika (*C. Hore*), ♂.
i. Ambriz (*Monteiro*), ♂.

Hewitson coll.

j. Cameroons, ♂.
k, l. Angola, ♂ ♂.

66. Charaxes Thysii *.

Charaxes Thysii, *Capronnier, Comptes Rend. Soc. Ent. Belg.* xxxiii. p. cxxv (1889).

Congo.

I have been quite unable to identify this species with anything we possess: it expands 2 inches, has the upper surface black-brown with blue reflections; the primaries with a submarginal series of blue spots uniting at the submedian vein into a metallic blue band which runs parallel to the outer margin of secondaries: so far the description answers fairly to the male of *C. laodice*, but the secondaries are said to have two short tails. Under surface silvery white, with a continuous brown submarginal line sprinkled with black markings on the secondaries, the border of these wings being also brown, with little black lunules; there are also spots and little interrupted lines of black at the base of the primaries, and a large black-brown patch at external angle.

11. C. tiridates Group.

67. Charaxes imperialis.

♂. Charaxes imperialis, *Butler, Trans. Ent. Soc.* 1874, p. 531, pl. xi. fig. 3; ♀. *Proc. Zool. Soc.* 1887, p. 570.

a. Sierra Leone (*Dr. Preuss*), ♂; from S. & G. coll.

b. Rio del Rey (*Johnston*), ♀.

The male is labelled "*Charaxes imperialis*, Stgr. in litt." It is surprising how careless Dr. Staudinger is in looking up the authorship of a species; however carefully it may have been figured and described, it is still in danger of being redescribed as new: this is repeatedly the case in his 'Exotische Schmetterlinge.'

C. imperialis is at present very rare in collections; for thirteen years the type in Mr. Swanzy's collection was the only specimen known to me.

68. Charaxes Ameliæ.

♂. Charaxes Ameliæ, *Doumet, Rev. Zool.* 1861, p. 171, pl. v. fig. 1; *Hewitson, Exot. Butt.* v. *Char.* pl. v. figs. 20, 21 (1876).

♂. Charaxes regius, *Aurivillius, Ent. Tidskr.* x. p. 191 (1889).

a–d. Sierra Leone (*Dr. Preuss*), ♂ ♂, ♀; from S. & G. coll.

e–g. Sierra Leone (*Barchard*), ♀ ♀.

* Since this paper was written, a coloured drawing of the type has been shown to me by Mr. Aurivillius; the species is allied to *C. Whytei*.

h, i. Sierra Leone (*P. Crowley*), ♂, ♀.
j. Victoria, Cameroons (*Druce coll.*), ♂; from S. & G. coll.
k. Old Calabar (*White*), ♂; from S. & G. coll.
l. Old Calabar (*Druce coll.*), ♂; from S. & G. coll.
m. Accra (*E. T. Carter*), ♀.

Hewitson coll.

n. Old Calabar, ♂.
o. Without locality, ♀.

69. CHARAXES PITHODORIS.

Charaxes pithodoris, *Hewitson, Ent. Month. Mag.* x. p. 57 (1873); *Exot. Butt.* iv. *Char.* pl. i. figs. 18, 19 (1874).

Charaxes pythodorus, *Kirby, Cat. Diurn. Lep., Suppl.* p. 478 (1877).

Charaxes nesæa, *H. Grose Smith, Ann. & Mag. Nat. Hist.* ser. 6, vol. iii. p. 132 (1889).

a, b. Lake Mweru (*R. Crawshay*), ♂ ♂.

Hewitson coll.

Type, *c.* Angola (*Rogers*), ♂.

This species, in the tailless character of the hind wings of the male, approaches the *C. mycerina* group; but the upper-surface pattern brings it nearer to *C. cithæron.*

70. CHARAXES CITHÆRON.

Charaxes cithæron, *Felder, Wien. ent. Monatschr.* iii. p. 398, pl. viii. figs. 2, 3 (1859).

a–c. Durban (*G. E. Shelley*), ♂ ♂, ♀; from S. & G. coll.
d–g. Natal (*Gueinzius*), ♂ ♂, ♀ ♀.
h, i. Natal (*Plant*), ♂ ♂.
j. Natal (*Bates coll.*), ♂; from S. & G. coll.
k. Transvaal, ♀; from S. & G. coll.
l–n. Zomba (*A. Whyte & Macclounie*), ♀ ♀, ♂.
o. Slopes of Kilima-njaro (*Hannington*), ♂.

Hewitson coll.

p–s. Natal, ♂ ♂, ♀ ♀.

71. CHARAXES SMARAGDALIS.

♂. Charaxes smaragdalis, *Butler, Proc. Zool. Soc.* 1865, p. 630, pl. 36. fig. 5; ♀. *Lep. Exot.* i. p. 5, pl. ii. fig. 1 (1869).

a. Sierra Leone (*Druce coll.*), ♂; from S. & G. coll.
b–d. Sierra Leone (*Dr. Preuss*), ♀, ♂ ♂; from S. & G. coll.
e–j. Sierra Leone (*Barchard*), ♂ ♂, ♀ ♀.
k. Cameroons, ♂.

l–m. Cameroons, ♂ ♂; from S. & G. coll.
n. Victoria, Cameroons (*Druce coll.*), ♂; from S. & G. coll.
Type, *o*. Congo (*Richardson*), ♂.
Hewitson coll.
p. Without locality, ♂.
q. Congo, ♀ (example figured in 'Lep. Exot.').

72. Charaxes princeps, sp. n.

♂. Differs from *C. smaragdalis* in the less produced, more truncated apex to the primaries, the outer margin almost straight; much shorter tails to secondaries; in colouring it is more violaceous; the blue band completely divided on the primaries to the first median branch and by two black spots on the interno-median interspace; secondaries with the first division of the blue band represented by a small isolated spot; border much less black, narrower, separating into ocelloid spots from median vein; under surface more lilacine than in *C. smaragdalis*. Expanse 97 millim.

a. Victoria, Cameroons (*Druce coll.*), ♂; from S. & G. coll.

73. Charaxes Monteiri.

Charaxes Monteiri, *Staudinger, Exot. Schmett.* p. 168, pl. lix. (1886).

Isle of St. Thomas, Guinea.

Not in the Museum collection.

74. Charaxes violetta.

Charaxes violetta, *H. Grose Smith, Entom. Month. Mag.* xxi. p. 247 (1885); *Rhop. Exot.* i. *Char.* pl. i. figs. 1–3 (1887).

a. Delagoa Bay (*Monteiro*), ♂.
b. Zanzibar (*Druce coll.*), ♀; from S. & G. coll.

75. Charaxes xiphares.

♀. Papilio xiphares, *Cramer, Pap. Exot.* iv. pl. ccclxxvii. figs. A, B (1782).
♂. Papilio thyestes, *Stoll, Suppl. Cram.* pl. xxxii. figs. 2, 2 *b* (1790).
Nymphalis thurius, *Godart, Enc. Méth.* ix. p. 354 (1823).
Nymphalis thieste, *Westwood, Gen. Diurn. Lep.* p. 307 (1850).

a. South Africa (*F. P. Mansel Weale*), ♂.
b, *c*. South Africa (*Sir Andrew Smith*), ♀ ♀.
Hewitson coll.
d, *e*. Without locality, ♀ ♀.
f. Cape of Good Hope, ♀.

76. CHARAXES NUMENES.

Nymphalis numenes, *Hewitson, Exot. Butt.* ii. *Nymph.* pl. ii. figs. 9–11 (1859).

a. West Africa, ♂; from S. & G. coll.
b. West Africa, ♀.
c, d. Without locality (*coll. Kaden*), ♂, ♀; from S. & G. coll.
e. Old Calabar, ♂; from S. & G. coll.
f. Cameroons (*Druce coll.*), ♀; from S. & G. coll.
g, h. Sierra Leone (*Dr. Preuss*), ♂ ♂; from S. & G. coll.
i. Sierra Leone (*Barchard*), ♀.
j. Accra, ♂.
k. Accra (*E. T. Carter*), ♂.
l, m. Croboe District, Accra (*Higlett*), ♂ ♂.

Hewitson coll.
Type, *n.* Sierra Leone, ♂.
o, p. Angola, ♂ ♂.
q. Fernando Po, ♀.

77. CHARAXES TIRIDATES.

♂. Papilio tiridates, *Cramer, Pap. Exot.* ii. pl. clxi. figs. A, B (1779).
♀. Papilio marica, *Fabricius, Ent. Syst.* iii. 1, p. 113 (1793).
Var., Charaxes mixtus, *Rothschild, Novit. Zool.* i. p. 536, pl. xii. fig. 8 (1894).

a. Sierra Leone (*Dr. Preuss*), ♂; from S. & G. coll.
b, c. Sierra Leone (*Plant*), ♀, ♂.
d. Sierra Leone (*P. Crowley*), ♂.
e, f. West Africa, ♂, ♀; from S. & G. coll.
g. Accra (*R. Trimen*), ♂.
h. Accra (*E. T. Carter*), ♀.
i. Lake Mweru (*R. Crawshay*), ♂.
j. Isubu, ♂.
k, l. Ashanti, ♂ ♂.

Var. *mixtus*, Roths.
m, n. Victoria, Cameroons (*Druce coll.*), ♂, ♀; from S. & G. coll.

Larger than the type from the Congo. There can be no doubt, I think, that the prominence of the white centres to the blue spots, unless proved to be peculiar to one locality only, can hardly indicate even a distinct race. Mr. Rothschild insists that the true female of *C. mixtus* resembles the male!

Hewitson coll. (normal type).

o, p. Without locality, ♂, ♀.
q, r. Sierra Leone, ♂ ♂.

78. Charaxes bipunctatus.

Charaxes bipunctatus, *Rothschild, Novit. Zool.* i. p. 536 (1894).

a. Croboe District, Accra (*Higlett*), ♂.

This appears to be distinct from *C. tiridates*, but is very nearly allied: the absence of tails, the glossy greenish blue of the upper surface, and the deep orange marginal spots are its best characters; the absence of some of the blue spots is less important.

79. Charaxes Bohemani.

♂. Charaxes Bohemani, *Felder, Wien. ent. Monatschr.* iii. p. 321, pl. vi. fig. 3 (1859); ♀. *Butler, Lep. Exot.* i. pl. x. fig. 3 (1870).

a–c. Angola (*Monteiro*), ♂ ♂; from S. & G. coll.
d. Angola (*Bates coll.*), ♀; from S. & G. coll.
e. Banks of the Congo (*Monteiro*), ♀.
f. Bembe (*Monteiro*), ♂.
g. Ngama's (*R. Crawshay*), ♂.
h. Lake Mweru (*R. Crawshay*), ♂.
i, j. Zomba (*Macclounie*), ♂ ♂.
k. Kandera (*Emin Pasha*), ♂.
l. Mamboia (*Dr. Kirk*), ♀; from S. & G. coll.
m. S. Salvado (*Grandy*), ♀; from S. & G. coll.

Hewitson coll.

n, o. Zambesi, ♂, ♀.
p, q. Without locality, ♂ ♂.

12. C. eupale Group.

80. Charaxes eupale.

Papilio eupale, *Drury, Ill. Exot. Ent.* pl. vi. fig. 3 (1782).
Papilio amasia, *Fabricius, Ent. Syst.* iii. 1, p. 136 (1793).

a–d. Ashanti, ♂ ♂, ♀.
e. Ashanti (*Horniman coll.*), ♂.
f, g. Croboe District, Accra (*Higlett*), ♂ ♂.
h. W. Africa (*J. Macgillivray*), ♂.
i. Angola, Bembe mines (*Monteiro*), ♂.
j. Angola (*Rogers*); from S. & G. coll.

k, l. Sierra Leone (*Barchard*), ♂ ♂.
m. Barombi, Cameroons (*Dr. Preuss*); from S. & G. coll.
n, o. Cameroons; from S. & G. coll.

Hewitson coll.

p, q. Without locality, ♂ ♂.
r. Cape Coast, ♂.
s. Angola, ♂.

13. C. delphis Group.

81. Charaxes delphis.

Charaxes delphis, *Doubleday, Ann. Soc. Ent. France,* 1843, p. 217, pl. 7.
Charaxes concha, *Vollenhoven, Tijd. voor Ent.* iv. p. 162, pl. x. figs. 1 & 3 (1861).

a. Labuan (*Low*), ♂; from S. & G. coll.
b, c. Borneo (*Low*), ♂ ♂; from S. & G. coll.
d. Borneo (*Bates coll.*), ♂; from S. & G. coll.
e. Palawan (*Dr. Platen*), ♂; from S. & G. coll.
f. Malacca (*Bates coll.*), ♂; from S. & G. coll.
g–i. Silhet (*Stainsforth*), ♂ ♂.

Hewitson coll.

j–l. Without locality, ♂ ♂.

It seems strange that all the specimens of this species which come to hand are males.

14. C. eudamippus Group.

82. Charaxes dolon.

Charaxes dolon, *Westwood, Cab. Orient. Ent.* pl. xxvii. figs. 2, 3 (1848).

a–d. Darjiling (*Lidderdale*), ♂ ♂; from S. & G. coll.
e, f. Sikhim (*G. C. Dudgeon*), ♂ ♂.
g. Sikhim (*Watson*), ♂.
h. N. India (*Capt. Boyes*), ♂.
i, j. Nepal (*General Ramsay*), ♂ ♂.

Hewitson coll.

k–n. Without locality, ♂ ♂.

In this species also, females would appear to be extremely rare. All that I have seen are males.

83. Charaxes eudamippus.

Charaxes eudamippus, *Doubleday, Ann. Soc. Ent. France,* 1843, p. 217, pl. vii.

Types, *a*, *b*. Silhet (*Stainsforth*), ♂, ♀.
c. Silhet (*Stainsforth*), ♂.
d. Darjiling (*H. J. Elwes*), ♂; from S. & G. coll.
e. Darjiling (*Bates coll.*), ♂; from S. & G. coll.
f. Mungphu (*Atkinson*), ♂.
g. Bhutan (*G. C. Dudgeon*), ♂.
h. Nepal (*Wright*), ♂.
i. Khasia Hills (*Col. Swinhoe*), ♂.
j. Meetan, Burmah (*A. O. Hume*), ♂; from S. & G. coll.
k. Tilin Yaw (*Watson*), ♂.
l. East Pegu (*W. Doherty*), ♂; from S. & G. coll.

Hewitson coll.
m–q. Without locality, ♂ ♂, ♀.

It is a great pity that Hewitson did not preserve the locality on his female specimen, that sex being very rare in collections.

84. Charaxes nepenthes.

Charaxes nepenthes, *H. Grose Smith, Entom. Month. Mag.* vol. xx. p. 58 (1883); *Rhop. Exot., Char.* pl. ii. figs. 3, 4 (1887).

a, *b*. Salween River, Shan States, Burmah (*Miss Rose Jackson*), ♂ ♂.

85. Charaxes Rothschildi.

Charaxes ganymedes, *Leech, Entomologist,* vol. xxiv. *Suppl.* p. 30 (1891), *not Staudinger.*

Charaxes Rothschildi, *Leech, Butt. China,* i. p. 128, pl. xiv. fig. 3 (1893).

Omei-shan and Moupin.

Not in the British Museum collection. It differs from *C. eudamippus* just as *C. mandarinus* does from *C. narcæus*, therefore it would not be surprising if we were to receive intergrades from one to the other. Mr. Leech renamed his species on the ground that Westwood had already used the name for a species of *Charaxes*! but Westwood (*loc. cit.*) gave the name *ganymede* (*sic*) to a *Morpho*, not a *Charaxes*. It was Staudinger who in 1886 used the name for a *Charaxes*.

86. CHARAXES NARCÆUS.

Nymphalis narcæus, *Hewitson, Exot. Butt.* i. *Nymph.* pl. i. figs. 1, 4 (1854).

Var., Charaxes mandarinus, *Felder, Reise der Nov., Lep.* iii. p. 437 (1867).

Charaxes narcæus, var. thibetanus, *Oberthür, Études d'Ent.* xv. p. 11, pl. ii. fig. 10 (July 1891).

Charaxes satyrina, *Butler*, var. menedemus, *Oberthür, l. c.* p. 13, pl. ii. fig. 9.

a, b. Shanghai (*W. B. Pryer*), ♂ ♂; from S. & G. coll.
c. North China, ♀.
Type, *d*. Shanghai (*Fortune*), ♂; "Chekiang," *Hew.*
e–h. Kiukiang (*Chas. Maries*), ♂ ♂.
Hewitson coll.
i. China, ♀.
Var. *mandarinus* = *thibetanus*.
j, k. North China (*Fortune*), ♂ ♂.
l. North China, ♂.
Hewitson coll.
m. Without locality, ♂.
n. China, ♀.

M. Oberthür's *C. menedemus* is typical *C. narcæus* and *C. thibetanus* typical *C. mandarinus*. I was not aware that I had given the name *C. satyrina* to any *Charaxes*, but M. Oberthür (instead of looking up the Zoological Records) seems to have been perfectly satisfied to accept a manuscript name attached to a specimen by a dealer (see Leech in Butt. China, p. 127).

87. CHARAXES POSIDONIUS.

Charaxes posidonius, *Leech, Entomologist*, vol. xxiv., *Suppl.* p. 30 (May 1891); *Butt. China*, i. p. 127, pl. xiv. fig. 4 (1893).

Charaxes clitiphron, *Oberthür, Études d'Ent.* xv. p. 12, pl. ii. fig. 11 (July 1891).

Wa-ssu-kow and Ni-tou.
Not in the Museum collection.

15. C. HADRIANUS GROUP.

88. CHARAXES HADRIANUS.

Charaxes hadrianus, *Ward, Ent. Month. Mag.* viii. p. 120 (1871).

Charaxes gabonica, *Crowley, Trans. Ent. Soc.* p. 553, pl. ii. fig. 1 (1891).

Gaboon.
Not in the Museum collection.

16. C. ATHAMAS GROUP.

89. CHARAXES JALYSUS.

Charaxes jalysus, *Felder, Reise der Nov., Lep.* iii. p. 438, pl. lix. fig. 5 (1867).

a–d. Borneo (*Low*), ♂ ♂; from S. & G. coll.
e. Sarawak (*Everett*), ♂; from S. & G. coll.
f. Perak (*Townsend*), ♂; from S. & G. coll.
g, h. Malacca (*Capt. Pinwill*), ♂ ♂.

This is a very distinct species which has been incorrectly associated with the *C. hebe* group; it really belongs to the opposite end of the series of species allied to *C. athamas*, the bordering of the wings on the under surface being narrowest in this species.

90. CHARAXES BHARATA.

Charaxes bharata, *Felder, Reise der Nov., Lep.* iii. p. 438 (1867).

a. Dharmsala (*Hocking*), ♂.
b. East India (*Dohrn, Zeller coll.*), ♀.
c. Darjiling (*Lidderdale*), ♂; from S. & G. coll.

The evident rarity of this form is rather suspicious; but it differs in so many respects from *C. athamas* that, without positive evidence, it would be presumptuous to regard it as a variety of that species: in its much narrower dark borders it is considerably nearer to *C. jalysus*.

91. CHARAXES HAMASTA.

Eulepis hamasta, *Moore, Proc. Zool. Soc.* 1882, p. 238.
Charaxes agrarius, *Swinhoe, l. c.* 1886, p. 425, pl. xl. fig. 3.

Types, *a, b.* Dharmsala (*Hocking*), ♂, ♀.
c. India (*coll. Banks*), ♂.
d. Mhow (*Col. Swinhoe*), ♂.
e, f. Tilin Yaw (*Watson*), ♂ ♂.
g. Chin Hills (*Watson*), ♂.

We next come to a form corresponding closely with *C. athamas* in pattern, and which I therefore regard as a variety of that species, but which, from the pale greenish-yellow colouring of the central area above, has been confounded with the narrow-bordered *C. bharata*.

92. CHARAXES ATHAMAS.

Papilio athamas, *Drury, Ill. Exot. Ent.* i. pl. ii. fig. 4 (1773).
Var. *a.* Charaxes samatha, *Moore, Proc. Zool. Soc.* 1878, p. 831.
Var. *b.* Charaxes attalus, *Felder, Reise der Nov., Lep.* iii. p. 438 (1867).
Charaxes Fruhstorferi, *Röber, Ent. Nachr.* xxi. n. 4, p. 63 (1895).
Charaxes phrixus, *Röber, l. c.* p. 64.

Var. 1. Resembling typical form, but with central band above pale greenish yellow as in *C. bharata.*

a. Assam (*Watson*), ♂.
b. Nepal (*Dr. Wright*), ♀.
c. Khasia Hills (*Watson*), ♂.
d. Sikhim (*Watson*), ♂.

Var. 2. Intermediate between var. 1 and typical form, the band above yellow but broad, inner apical spot large and quadrate.

a. Káli valley, N.W. India (*J. F. Duthie*), ♂.
b. Landoor (*General Hearsay*), ♂.
c. Darjiling (*H. J. Elwes*), ♂; from S. & G. coll.
d. Kullar, Nilghiris (*Davison*), ♂; from S. & G. coll.
e. Kandy (*Major Yerbury*), ♀.
f. Ceylon (*Major Yerbury*), ♂.

Hewitson coll.

g, h. Simla, ♂ ♂.

Var. 3. Typical. (Drury's type was from China.)

a. Nepal (*Dr. Wright*), ♂.
b. Darjiling (*Lidderdale*), ♂; from S. & G. coll.
c. Mylang River (*Dr. G. Watt*), ♂.

Var. 4. *C. samatha*, Moore.

a. Upper Tenasserim (*Wood-Mason*), ♂.
b–e. Tilin Yaw (*Watson*), ♀, ♂ ♂.
f. Rangoon (*J. G. Scott*), ♂.
g. Rangoon (*Cowen*), ♂.
h. Andamans (*Commander A. Carpenter*), ♂.
i. Ceylon (*Jameson*), ♂.
j, k. Ceylon (*Col. Yerbury*), ♂ ♂.
l. Ceylon (*Whyte*), ♂; from S. & G. coll.
m–o. Philippines (*Dr. Platen*), ♂ ♂; from S. & G. coll.
p, q. Philippines (*Semper*), ♂ ♂; from S. & G. coll.

Philippine examples have the submarginal red spots on the secondaries better developed than in those from Burma and Ceylon.

Var. 5. *C. attalus*, Felder.

a. Borneo, ♂.
b. Sarawak (*Everett*), ♂; from S. & G. coll.
c–e. Labuan (*Low*), ♂ ♂; from S. & G. coll.
f. Sumatra (*Sachs*), ♂; from S. & G. coll.
g. Perak (*Townsend*), ♂; from S. & G. coll.
h–o. Java (*Horsfield*), ♂ ♂, ♀ ♀.

Bornean examples approach very closely to typical *C. samatha*; those from Sumatra and Java have the central band usually yellower, and most examples have two subapical spots on the primaries.

93. Charaxes alphius.

Charaxes alphius, *Staudinger, Exot. Schmett.* p. 172 (1886).

a, b. Timor (*from Staudinger*), ♂ ♂; from S. & G. coll.
c. Timor (*Wallace*), ♂; from S. & G. coll.
d, e. Sambawa (*Staudinger*), ♂ ♂; from S. & G. coll.

Nearly allied to the Javan form of *C. athamas*, but the inner subapical spot geminate.

94. Charaxes arja.

Charaxes arja, *Felder, Reise der Nov., Lep.* iii. p. 438 (1867).
Papilio pyrrhus, *Donovan, Ins. Ind.* pl. 29. fig. 3 (1800).

a. Landour (*Lidderdale*), ♂; from S. & G. coll.
b–e. Silhet (*Sowerby*), ♂ ♂, ♀.
f. Darjiling (*Lidderdale*), ♂; from S. & G. coll.
g, h. Sikhim (*G. C. Dudgeon*), ♂ ♂.
i, j. Sikhim (*G. F. Hampson*), ♂ ♂; var. *pyrrhus*, Don.
k. Moulmein (*Clark*), ♀.
l, m. Rangoon (*Watson*), ♂.
n, o. Rangoon (*Cowen*), ♂ ♂; from S. & G. coll.
p. Thayetmyo (*Watson*), ♂.
q. Toungoo (*Watson*), ♂.
r, s. Tilin Yaw (*Watson*), ♂ ♂.
t. Karen Hills (*Watson*), ♂.

Var. with narrower black borders: less brown at base.

u. Darjiling (*Lidderdale*), ♂; from S. & G. coll.
v. Darjiling (*Mrs. R. V. Boyle*), ♂.

Hewitson coll.

w. Silhet, ♂.
x. Cherra Poonjee, ♂; white band very narrow (nearly resembles *g*).

95. Charaxes fallax.

Charaxes fallax, *Röber, Entom. Nachr.* xx. n. 19, p. 294 (1894).
Charaxes javanus, *Röber, l. c.* xxi. p. 66 (1895).

a. Java ? (*J. Reeves*), ♂.

Var. *C. javanus.* (See Swainson's Zool. Ill. 2nd ser. xi. pl. 90.) The type is evidently a starved specimen.

b. Java, ♂.
c. Java (*Wallace*), ♂; from S. & G. coll.

Herr J. Röber admits that these two forms, which scarcely differ, certainly fly together; "whereby the independence of both forms is evidenced," he says. I should have thought the fact clearly proved their specific identity. Herr Frühstorfer thinks that our examples are not true *C. javanus*, and that the latter is a synonym of *C. Moorei*; he, however, writes from memory, but the two species are certainly very nearly related.

96. Charaxes Moorei.

Charaxes Moorei, *Distant, Rhop. Malay.* p. 108, pl. xiii. fig. 3 (1883).
Charaxes kaba, *Kheil, Fauna Indo-Malay. Arch.* p. 27, pl. iii. (1884).
Charaxes heracles, *Röber, Entom. Nachr.* xx. n. 19, p. 294 (1894).

a, b. Borneo (*Low*), ♂ ♂; from S. & G. coll.
c. Sumatra (*Sachs*), ♂; from S. & G. coll.
d. Moulmein (*Clark*), ♂.

Hewitson coll.

e. Borneo, ♂.
f. Burma, ♀.

Kheil's figure certainly appears to me to be a good representation of this species, and therefore I follow Mr. Distant in placing it as a synonym.

97. Charaxes hebe.

♀. Charaxes hebe, *Butler, Proc. Zool. Soc.* 1865, p. 634, pl. xxxvii. fig. 3.
♂. Charaxes albanus, *Röber, Entom. Nachr.* xxi. n. 4, p. 66 (1895).
Var. ♂. Charaxes ganymedes, *Staudinger, Exot. Schmett.* p. 173 (1886).

a–c. Malacca (*Pinwill*), ♂ ♂, ♀.
d, e. Borneo (*Low*), ♂ ♂.

Type, *f.* Sumatra, ♀.

Hewitson coll.

g. Sumatra, ♂ (agrees with description of *C. albanus*).

I have seen a typical example of *C. ganymedes* from W. B. Pryer's collection; it is merely a slight melanism of the type form.

17. C. Kadenii Group.

98. Charaxes Kadenii.

Charaxes Kadenii, *Felder, Wien. ent. Monatschr.* iv. p. 232, pl. iii. fig. 2 (1860).

Type, *a.* Without locality (*Kaden coll.*), ♂; from S. & G. coll.
b. W. Java (*Staudinger*), ♂; from S. & G. coll.

Hewitson coll.
c. Java, ♂.

This species seems to be a type intermediate between the *C. athamas* and *C. Schreiberi* groups.

18. C. Schreiberi Group.

99. Charaxes Schreiberi.

Nymphalis Schreiberi, *Godart, Enc. Méth.* ix. *Suppl.* p. 825 (1823).
Paphia Schreibers, *Horsfield, Cat. Lep. E. I. Comp.* pl. vi. figs. 3, 3 *a* (1829).

a–c. Malacca (*Pinwill*), ♂ ♂.
d. Sumatra (*Sachs*), ♀; from S. & G. coll.
e. Billiton I. (*Walter*), ♀; from S. & G. coll.
f. Java (*Druce coll.*), ♀; from S. & G. coll.
g. Java (*Horsfield*), ♀.
h. Labuan (*Low*), ♂; from S. & G. coll.
i. India, ♂; from S. & G. coll.
j. Assam (*Warwick*), ♂.

Hewitson coll.
k. Java, ♂.
l, m. Borneo, ♂ ♂.

100. Charaxes niasicus.

Charaxes niasicus, *Butler, Ent. Month. Mag.* xx. p. 50 (1883).
a. Isl. of Nias (*Dr. A. Schreiber*), ♂.

101. Charaxes cognatus.

Charaxes cognatus, *Vollenhoven, Tijd. voor Ent.* iv. p. 159, pl. ix. figs. 1, 2 (1861).
Moluccas.

Not in the Museum collection.

19. C. PYRRHUS GROUP.

102. CHARAXES PYRRHUS.

Papilio pyrrhus, *Linnæus, Mus. Lud. Ulr.* p. 205 (1764); *Clerck, Icones,* pl. 25. fig. 2 (1764).

Nymphalis pyrrhus, *Lucas, Lep. Exot.* pl. 63. fig. 2 (1835).

a. Amboina, ♂.
b. Without locality (*coll. Kaden*), ♀; from S. & G. coll.
c. Amboina (*Bates coll. from Wallace*), ♂; from S.& G.coll.

103. CHARAXES JUPITER.

Charaxes jupiter, *Butler, Lep. Exot.* i. p. 14, pl. v. figs. 4, 7 (1869).

Var., Charaxes attila, *Grose Smith, Entom. Month. Mag.* xxv. p. 301 (1889); *Rhop. Exot.* i. *Char.* pl. v. figs. 1, 2 ♂ (1891).

a–d. Port Moresby, N. Guinea (*Goldie*), ♂ ♂; from S. & G. coll.
e. Duke of York Island, ♂.
f. Duke of York Island (*G. Brown*), ♂; from S. & G. coll.
g–i. Guadalcanar (*Woodford*), ♀ ♀; from S. & G. coll.

The differences pointed out by Mr. Grose Smith to distinguish *C. attila* from *C. jupiter* are only such as occur between specimens of *C. sempronius*.

104. CHARAXES GALAXIA.

Charaxes galaxia, *Butler, Proc. Zool. Soc.* 1865, p. 633, pl. xxxvii. fig. 2; *Grose Smith, Rhop. Exot.* i. *Char.* pl. ix. figs. 3, 4 (1891).

a–c. Timor (*Wallace*), ♂ ♂; from S. & G. coll.
d. Locality unrecorded, ♂; from S. & G. coll.

Types, *e, f.* Timor (*Wallace*), ♂ ♂.

Hewitson coll.

g, h. Timor (*Wallace*), ♂ ♂.

105. CHARAXES GILOLENSIS.

Charaxes gilolensis, *Butler, Lep. Exot.* i. p. 14, pl. v. fig. 6, pl. vi. fig. 3 (1869).

"Gilolo and Batchian."

a. Batchian (*Dr. Platen*), ♂; from S. & G. coll.

Hewitson coll.

Type, *b.* Batchian (*Wallace*), ♂.

106. Charaxes sempronius.

Papilio sempronius, *Fabricius, Ent. Syst.* iii. 1, p. 62 (1793).
Jasia australis, *Swainson, Zool. Ill., Ins.* ii. pl. 114 (1833).
Var., Charaxes tyrtæus, *Felder, Wien. ent. Mon.* iii. p. 399, pl. ix. fig. 3 (1859).

a. N.E. Australia (*J. Brenchley*), ♂.
b. Rockingham Bay (*Macgillivray*), ♀.
c. Queensland (*Macleay*), ♂; from S. & G. coll.
d. Moreton Bay (*Bates coll.*), ♀; from S. & G. coll.
e. Sydney (*Macleay*), ♂; from S. & G. coll.
f, g. Without locality (*coll. Kaden*), ♂ ♂; from S. & G. coll.
Var. *tyrtæus*, *h.* Sydney (*Macleay*), ♀; from S. & G. coll.
i. South Creek, New Holland (*J. Hunter*), ♂.
j. South-east Australia (*E. Damel*), ♂.
k, l. South-east Australia (*Stutchbury*), ♂, ♀.
Hewitson coll.
m, n. Without locality, ♂, ♀.
o. Australia, ♀.

107. Charaxes clitarchus.

Charaxes clitarchus, *Hewitson, Exot. Butt.* v. pl. iv. figs. 16, 17 (1874).

a. Lifu (*Rev. S. J. Whitmee*), ♂.
b–d. New Caledonia (*Layard*), ♂ ♂; from S. & G. coll.
Hewitson coll.
Type, *e.* New Caledonia, ♂ (no locality label on specimen).

108. Charaxes caphontis.

♀. Charaxes caphontis, *Hewitson, Exot. Butt.* iii. *Char.* pl. iii. figs. 14, 15 (1862).

Hewitson coll.
Type, *a.* Port Denison, Australia, ♀.

109. Charaxes epigenes.

Charaxes epigenes, *Godman & Salvin, Ann. & Mag. Nat. Hist.* ser. 6, vol. i. p. 210 (1888).

a–d. Aola, Guadalcanar (*Woodford*); from S. & G. coll.

20. C. nitebis Group.

110. Charaxes nitebis.

Nymphalis nitebis, *Hewitson, Exot. Butt.* ii. *Nymph.* pl. ii. figs. 7, 8 (1859).

a, b. Celebes (*coll. Druce*), ♂ ♂; from S. & G. coll.
c, d. Minahassa, Celebes, ♀, ♂; from S. & G. coll.
e. Macassar, Celebes (*Wallace*), ♂.

Hewitson coll.

f, g. Celebes (*Wallace*), ♂ ♂.
h. Without locality, ♂.

This species forms a good transitional form from the *C. pyrrhus* to the *C. psaphon* group, which is rather interfered with by the necessity for putting *C. Durnfordi* next to it; there must always be these drawbacks to a linear arrangement of species.

21. C. Durnfordi Group.

111. Charaxes Durnfordi.

Charaxes Durnfordi, *Distant, Entom.* xvii. p. 191 (1884); *Rhop. Mal.* p. 432, pl. xl. fig. 8 (1886).

Local form. Charaxes Nicholii, *Grose Smith, Ann. & Mag. Nat. Hist.* ser. 5, vol. xviii. p. 150 (1886); *Rhop. Exot.* i. *Char.* pl. ii. figs. 1, 2 (1887).

a. E. Pegu (*W. Doherty*), ♂; from S. & G. coll.

112. Charaxes Everetti.

Charaxes Everetti, *Rothschild, Deutsche ent. Zeit., Lep.* vi. p. 348 (1893).

Baram, British North Borneo.

The Bornean representative of the preceding species.

113. Charaxes Staudingeri.

Charaxes Staudingeri, *Rothschild, Deutsche ent. Zeit., Lep.* vi. p. 349 (1893).

Java.

Represents *C. Durnfordi* in Java.

22. C. psaphon Group.

114. Charaxes antonius.

Charaxes antonius, *Semper, Verh. Ver. Hamburg,* iii. p. 113 (1878); *Reisen in Arch. Phil., Tagf.* pl. xiv. figs. 6–8 (1887).

a–c. S.E. Mindanão (*Dr. Platen*), ♂ ♂, ♀; from S. & G. coll.
d. Mindanão, ♂.

Hewitson coll.

e. Philippines, ♂.
f. Without locality, ♂.

115. Charaxes Plateni.

Charaxes Plateni, *Staudinger, Deutsche ent. Zeit., Lep.* p. 82 (1889).

a. Palawan, Philippines (*Dr. Platen*), ♂ ; from S. & G. coll.

The upper surface of this species is much like *C. psaphon*, but the tawny basal area of the primaries is smaller: the under surface is exceptionally white for this group.

116. Charaxes psaphon.

♂. Charaxes psaphon, *Westwood, Cab. Orient. Ent.* pl. xxi. figs. 1, 2 (1848).

♀. Charaxes serendiba, *Moore, Lep. Ceyl.* i. p. 30, pl. xv. fig. 3 (1880).

a, b. Trincomali (*Col. Yerbury*), ♂, ♀.
c–h. Kandy (*Col. Yerbury*), ♂ ♂, ♀.
i, j. Ceylon (*Mrs. Lindesay*), ♂, ♀.
k, l. Ceylon (*Whyte*), ♂ ♂; from S. & G. coll.
m, n. Ceylon (*Jameson*), ♂ ♂.

Local race: *Charaxes imna*, Butler, Trans. Ent. Soc. 1870, p. 122, pl. iv. fig. 2.

o, p. Nilgiris (*Hampson*), ♂, ♀.
q. Bombay, ♂; from S. & G. coll.
r. Bombay (*Hunter*), ♀.
s. Bombay (*Dr. Leith*), ♂.

Hewitson coll.

t. Calcutta, ♂.

117. Charaxes hierax.

Charaxes hierax, *Felder, Reise der Nov., Lep.* iii. p. 442 (1867).
Charaxes Watti, *Butler, Proc. Zool. Soc.* 1880, p. 148, pl. xv. fig. 2.

a. China (*coll. Kaden*), ♂; from S. & G. coll.
b. N. India, ♂; from S. & G. coll.
Type, *c.* Upper Assam (*Dr. Watt*), ♂.
d. Silhet (*Stainsforth*), ♂.

118. Charaxes harpax.

Charaxes harpax, *Felder, Reise der Nov., Lep.* iii. p. 444 (1867).
Charaxes agna, *Moore, Proc. Zool. Soc.* 1878, p. 832.

a–h. Borneo (*Low*), ♂ ♂, ♀ ♀; from S. & G. coll.
i. Borneo (*Bates coll.*), ♂; from S. & G. coll.

j, k. Borneo, ♂ ♂.
l, m. Sarawak (*Everett*), ♂ ♂; from S. & G. coll.
n. Sarawak (*Brooke*), ♂.
o. Sumatra (*Sachs*), ♂; from S. & G. coll.
p. East Pegu (*W. Doherty*), ♂; from S. & G. coll.
Type, *q.* Upper Tenasserim (*Wood-Mason*), ♂.
r. Assam (*Dr. Watt*), ♂.
s. Silhet (*Stainsforth*), ♂.

Hewitson coll. (as *C. affinis*).
t. Borneo, ♂.

119. Charaxes baya.

Charaxes baya, *Moore, Cat. Lep. E. I. Co.* i. p. 207 (1857); ♂, *Butler, Proc. Zool. Soc.* 1865, pl. xxxvii. fig. 5.

Types, *a, b.* Java (*Horsfield coll.*), ♂, ♀.
c–e. Sarawak (*Everett*), ♂; from S. & G. coll.
f. Sarawak (*Bartlett*), ♂.
g–i. Borneo (*Low*), ♂ ♂; from S. & G. coll.

The following is, perhaps, only a form of *C. baya* occurring in Burma, the Philippines, &c.

120. Charaxes corax.

Charaxes corax, *Felder, Reise der Nov., Lep.* iii. p. 444 (1867).

a. Moulmein (*Archdeacon Clark*), ♂.
b. Mergui (*Commander Alfred Carpenter*), ♂.
c–e. Tenasserim (*Capt. Chas. Bingham*), ♂ ♂.
f. Philippines (*Druce coll.*), ♂; from S. & G. coll.
Var., *g.* Elephant Island (*Rev. Deans Cowan*), ♂.

Dwarfed form = *C. bayula*, Staud. in litt.
h, i. Palawan (*Dr. Platen*), ♂ ♂; from S. & G. coll.

121. Charaxes georgius.

Charaxes georgius, *Staudinger, Deutsche ent. Zeit., Lep.* v. p. 262 (1892).

a–c. Mindoro (*Dr. Platen*), ♂ ♂, ♀; from S. & G. coll.

122. Charaxes hemana.

Charaxes hemana, *Butler, Trans. Ent. Soc.* 1870, p. 122, pl. iv. fig. 1.

a. North India, ♂.
b–d. Mussuri (*Lidderdale*), ♂ ♂, ♀; from S. & G. coll.
e. North of Landoor (*Lidderdale*), ♀.

123. Charaxes repetitus, sp. n.

♂. The Bornean representative of *C. polyxena*. Above tawny, deepening to mahogany-brown towards anal angle of secondaries; external border of primaries black, narrowest at external angles (about 6 millims.), enclosing a transverse oblique elliptical spot of the ground-colour near its inner margin, on internomedian interspace, gradually widening above the latter to third median branch where it is 13 millimetres wide, thence running obliquely inwards to costa where it attains its greatest width of 1 inch; area immediately within the angle, from costa to first median branch yellowish, bounded internally by a black irregular discocellular marking, and three irregularly placed lunules, a trace of a fourth interrupted lunule on the internomedian area; secondaries with the apical area smoky black, forming a vague diffused patch, on which are two white points, the outer half of the veins, which pass through this patch, black; the outer half of the area between the latter and the origin of the costal vein yellowish, bounded internally by an oblique blackish dash; outer border deepening to mahogany-brown and with a smoky blackish marginal stripe; a submarginal series of five diffused black spots, bounded internally by white transverse dashes, the last of these accompanied by a few violet scales. Body normal: under surface glaucous violaceous ash-coloured, with the usual darker areas somewhat olivaceous; other markings much as usual, but not strongly defined. Expanse of wings 91 millimetres.

a. Sarawak (*Everett*), ♂.

There can be no question as to this being a distinct species, although not sufficiently different from its allies to be of startling interest.

124. Charaxes polyxena.

♀. Papilio polyxena, *Cramer, Pap. Exot.* i. pl. liv. A, B (1779).

a. Without locality (*coll. Kaden*), ♂; from S. & G. coll.
b. China (*Brenchley*), ♀.

125. Charaxes Bernardus.

♀. Papilio Bernardus, *Fabricius, Ent. Syst.* iii. 1, p. 71 (1793); *Donovan, Ins. China*, pl. 35 (1789).

a. Without locality (*coll. Druce*), ♂; from S. & G. coll.
b. China, ♀.
c. "N. India" (*E. I. Museum*), ♀.

Probably a seasonal form of the preceding, which it nearly resembles; the male has a trace of white beyond the cell of primaries and less falcate wings, with scarcely any tawny marking on the black border.

From Tilin Yaw we have a male example of a *Charaxes*, collected by Mr. E. Y. Watson, which, on the upper surface so nearly approaches *C. bernardus* ♂ in general aspect and colouring, that I cannot venture to separate it; its under-surface colouring is, however, considerably darker. Possibly this will prove to be an aberrant form of some well-known and abundant species.

126. CHARAXES HIPPONAX.

Charaxes hipponax, *Felder, Reise der Nov., Lep.* iii. p. 443 (1867).
Var., Charaxes hindia, *Butler, Lep. Exot.* xii. pl. xxxvii. fig. 5 (1872).
Var., Charaxes jalinder, *Butler, l. c.* pl. xxxvii. fig. 4 (1872).

Var. *C. hindia.*

a. Mungphu (*Atkinson*), ♂.
b. India, ♀; from S. & G. coll.

Transitional forms to *C. jalinder.*

c. Bhotan (*Lidderdale*), ♂.
d. Bhotan (*Knyvett*), ♂; from S. & G. coll.
e, f. Darjiling (*Druce coll.*), ♂ ♂; from S. & G. coll.
g, h. Mungphu (*Atkinson*), ♂.
i. Sikhim (*Lidderdale*), ♂.
j–r. Chin Hills, Burmah (*Watson*), ♂ ♂.
s. Moulmein (*Archdeacon Clark*), ♀.

Var. *C. jalinder*, typical.

t. Mungphu (*Atkinson*), ♂.
u. Darjiling (*Lidderdale*), ♀.
v–x. Darjiling (*Druce coll.*), ♂ ♂, ♀.
y. Bhotan (*Lidderdale*), ♀.

Hewitson coll. as (*C. polyxena*).

z. Without locality, ♀.
aa. India, ♂.

True *C. hipponax* (probably wet-season form).

bb, cc. North India, ♂, ♀.

dd. Darjiling (*Miss H. Dendy*), ♂.
ee. Darjiling (*Indian Museum*), ♂.
ff. Darjiling (*J. Fotheringham*), ♂.
gg. Assam (*Dr. Watt*), ♂.
hh. North India, ♂.
ii, jj. Nepal (*Hardwicke*), ♂, ♀.
kk. Khasia Hills (*Watson*), ♂.
ll. Chin Hills, Burmah (*Watson*), ♂.

127. Charaxes bupalus.

Charaxes bupalus, *Staudinger*, *Deutsche ent. Zeit., Lep.* 1889, p. 84.
a, b. Palawan (*Dr. Platen*), ♂ ♂; from S. & G. coll.

128. Charaxes borneensis.

Charaxes borneensis, *Butler*, *Lep. Exot.* i. p. 16, pl. vi. fig. 2 (1869).
a, b. Baram (*Everett*), ♂ ♂.
c–e. Borneo (*Low*), ♂ ♂; from S. & G. coll.

129. Charaxes pleistoanax.

Charaxes pleistoanax, *Felder*, *Reise der Nov., Lep.* iii. p. 443 (1867).
Var., Charaxes khasianus, *Butler*, *Lep. Exot.* xii. pl. xxxvii. fig. 6 (1872).
Var., Charaxes khimalara, *Butler*, *l. c.* fig. 1.

Typical form.
a. Sikhim (*G. F. Hampson*), ♂.
b. Darjiling (*J. Fotheringham*), ♂.
c. Bhutan (*G. C. Dudgeon*), ♂.
d. Assam (*coll. Druce*), ♂; from S. & G. coll.

Hewitson coll. (as *C. polyxena*).
e. Without locality, ♂.

Var. *C. khasianus* (probably the dry-season form).
f. Darjiling (*G. A. J. Rothney*), ♂.
g. Darjiling (*Lidderdale*), ♀.
h. Darjiling (*Lidderdale*), ♂; from S. & G. coll.
i. Darjiling (*coll. Druce*), ♂; from S. & G. coll.
j. Darjiling (*H. J. Elwes*), ♀; from S. & G. coll.
k. Darjiling (*Indian Museum*), ♂.
l. Sikhim (*Dr. T. C. Jerdon*), ♂.

Dr. F. Moore is of opinion that *C. khasianus* is distinct from *C. pleistoanax*, but it chiefly differs in its clearer and brighter

colouring; I cannot believe it to be more than a seasonal variety: the female differs rather more than the male.

Var. *C. khimalara* (probably extreme wet-season form).

m. Buxa (*G. F. Hampson*), ♂.

n Darjiling (*J. Fotheringham*), ♂.

This completes the so-called *C. psaphon* group, and commences the *C. marmax* group; the latter might formerly have been again subdivided on account of the two types of males, only the species now can be arranged to show a gradual transition from the one type to the other; the females show great uniformity of character throughout the entire series.

23. C. MARMAX GROUP.

130. CHARAXES CIMON.

Charaxes cimon, *Felder, Reise der Nov., Lep.* iii. p. 439, pl. lviii. figs. 6, 7 (1867).

a, b. Batchian (*Wallace*), ♂, ♀; from S. & G. coll.

c. Batchian (*Dr. Platen*), ♀; from S. & G. coll.

Hewitson coll. as *C. affinis.*

d. Batchian, ♂.

131. CHARAXES PAPUENSIS.

Charaxes papuensis, *Butler, Lep. Exot.* p. 15, pl. vi. fig. 1 (1869).
Charaxes cimonides, *Rothschild, Novit. Zool.* ii. p. 356 (1894).

a. N.W. New Guinea (*Burke*), ♂.

It is possible that there may be two species of nearly allied *Charaxes* in New Guinea; but it seems more probable that the differences between *C. papuensis* and *C. cimonides* indicated by Mr. Rothschild are of seasonal than specific value. However, with only one example before me, I do not feel competent to form any decided opinion on this point and am quite open to conviction.

132. CHARAXES LAYARDI, sp. n.

♂. A representative of *C. cimon*, larger; the inner edge of the black border of primaries deeply notched and not quite so wide; a black bar on the discocellulars in all the wings, but no markings between the latter and the black border; the black border of the secondaries narrower, the ocelloid submarginal spots more

isolated, not pupilled, excepting towards anal angle; under surface altogether redder than in *C. cimon*, the ocelloid patches on the secondaries smaller, forming a narrower belt, less brightly coloured, and with their outer marginal black spots narrower and more lunate in character; outer border more uniform in colouring, tawny, with greyer marginal band. Expanse of wings 99 millims.

Type, *a*. New Britain (*Mus. Godeffroy*), ♂.
b, *c*. New Ireland (*Layard*), ♂ ♂; from S. & G. coll.

133. Charaxes mars.

Charaxes mars, *Staudinger, Exot. Schmett.* p. 171 (1886).

Celebes.

This very fine species appears to belong to the *C. cimon* group; it is not in the Museum series.

134. Charaxes fervens, sp. n.

♂. Size and general form of *C. Layardi*: pattern above very similar to that of *C. baya*, but with the broadest portion of the outer border of the primaries produced inwardly, the divided black spot on the discocellulars and the black marginal lunate streaks on the secondaries of *C. parmenion* (*C. latona*, ♂); the apical patch and submarginal spots of the hind wings however remain as in *C. baya*: on the under surface the pattern and colouring show distinct affinity to *C. cimon* and allies, the band before the middle is however better defined, standing out in rufous on a yellowish background, and on the primaries it is more oblique than in any of the allied species.

a. Nias (*Dr. Schreiber*).

135. Charaxes affinis.

♂. Charaxes affinis, *Butler, Proc. Zool. Soc.* 1865, p. 636, pl. xxxvii. fig. 4.

♀. Charaxes Wallacei, *Butler, Lep. Exot.* p. 100, pl. xxxviii. fig. 2 (1872).

♂ var., Charaxes demonax, *Felder, Reise der Nov., Lep.* iii. p. 440 (1867).

Type, *a*. Macassar (*Wallace*), ♂.
b. Menado (*Dr. Meyer*), ♀.
c. Ternate (*Wallace*), ♂, var. *demonax*; from S. & G. coll.

Hewitson coll.
d. Macassar, ♂.

Type, *e*. Macassar, ♀, as *C. polyxena*.

136. CHARAXES LATONA.

♀. Charaxes latona, *Butler, Proc. Zool. Soc.* 1865, p. 636, pl. xxxvii. fig. 1.

Charaxes brennus, *Felder, Reise der Nov., Lep.* iii. p. 439, pl. lix. figs. 1, 2 (1867).

♂. Charaxes parmenion, *Felder, l. c.* n. 717.

Charaxes aruanus, *Butler, Lep. Exot.* p. 100 (1872).

a. Near Macassar (*Wallace*), ♂ = *C. parmenion.*

Type, *b.* Timor (*Wallace*), ♀.

c. Amboyna, ♂; from S. & G. coll.

d. Aru (*Wallace*), ♀ = *C. aruanus*; from S. & G. coll.

Hewitson coll. (as *C. affinis*).

e. Without locality, ♂.

137. CHARAXES SCYLAX.

Charaxes scylax, *Felder, Reise der Nov., Lep.* iii. p. 442 (1867).

a. Java (*Argent*), ♂.

138. CHARAXES AMYCUS.

Charaxes amycus, *Felder, Wien. ent. Monatschr.* v. p. 303 (1861).

Charaxes lunawara, *Butler, Lep. Exot.* pl. xxxvii. fig. 2 (1872).

a, b. Davao, S.E. Mindanão (*Dr. Platen*), ♂, ♀; from S. & G. coll.

c. Philippines (*Bates coll.*), ♂; from S. & G. coll.

♀. Type of *C. lunawara.* } *d.* Without locality (*Druce coll.*), ♀*; from S. & G. coll.

Hewitson coll. (as *C. polyxena*).

e. Philippines, ♀.

139. CHARAXES ARISTOGITON.

Charaxes aristogiton, *Felder, Reise der Nov., Lep.* iii. p. 445 (1867).

Charaxes desa, *Moore, Proc. Zool. Soc.* 1878, p. 832.

a–c. Darjiling (*H. J. Elwes*), ♂ ♂; from S. & G. coll.

d. Sikhim, ♂.

Type of *C. desa.* } *e.* Upper Tenasserim (*Wood-Mason*), ♂.

Dr. Moore has considered *C. desa* distinct on the ground that the inner edge of the black border of the primaries is produced inwards, to some distance beyond the lunate markings, upon the costal area; this character, however, is certainly no more constant in this species than in the allied *C. marmax.*

* The male of *C. lunawara* is a slight variation of *C. marmax.*

140. CHARAXES MARMAX.

Charaxes marmax, *Westwood, Cab. Orient. Ent.* pl. xxi. figs. 3–5 (1848).

a–c. Darjiling (*H. J. Elwes*), ♂ ♂, ♀; from S. & G. coll.
d. Darjiling (*Lidderdale*), ♀.
e, f. Darjiling (*Mrs. R. V. Boyle*), ♂ ♂.
g, h. Khasia Hills (*Watson*), ♂ ♂.
i. Assam (*Watson*), ♂.
j. Silhet (*E. Doubleday*), ♂.
k. Silhet (*Stainsforth*), ♂.
l. Buxa (*Knyvett*), ♂; from S. & G. coll.
m. Mungphu (*Atkinson*), ♂.
n. East Pegu (*W. Doherty*), ♂; from S. & G. coll.

Hewitson coll. (as *C. polyxena*).

o. Without locality, ♂.

141. CHARAXES KAHRUBA.

Haridra kahruba, *Moore, Lepid. Ind.* vol. ii. p. 235, pl. 171. figs. 1 *a–c* (1895).

a. Assam (*coll. Druce*), ♂; from S. & G. coll.
b. Darjiling (*Lidderdale*), ♀.
c. Darjiling (*Lidderdale*), ♀; from S. & G. coll.
d. Darjiling (*Mrs. R. V. Boyle*), ♂.
e, f. Mungphu (*Atkinson*), ♂ ♂.
g. Bhutan (*G. C. Dudgeon*), ♂.
h. Silhet (*Argent*), ♂.

Hewitson coll. (as *C. polyxena*).

i. Silhet, ♂.
j. North India, ♂.

142. CHARAXES HARMODIUS.

Charaxes harmodius, *Felder, Reise der Nov., Lep.* iii. p. 445 (1867).

a, b. Palawan, Philippines (*Dr. Platen*), ♂ ♂.

The above specimens are labelled as "*C. harpagon*, Staud.," apparently a MS. name; they agree perfectly with the description of Felder's species from Java.

143. CHARAXES DISTANTI.

Charaxes Distanti, *Honrath, Berl. ent. Zeit.* xxix. p. 277 (1885).

a, b. Borneo (*Low*), ♂ ♂; from S. & G. coll.
c. N.W. Borneo (*Everett*), ♂.
d, e. Borneo, ♂ ♂.

This species has much the aspect of a ruddy-bordered *C. marmax*, but the submarginal lunules on the under surface are far more silvery.

24. C. EURYALUS GROUP.

144. CHARAXES EURYALUS.

Papilio euryalus, *Cramer, Pap. Exot.* i. pl. lxxiv. A, B (1779).

♀. Papilio nisus, *Cramer, l. c.* ii. pl. cl. A, B (1779).

a. Without locality (*coll. Kaden*), ♂; from S. & G. coll.
b. Amboina (*Wallace*), ♂; from S. & G. coll.
c. Amboina (*Wallace*), ♂.

Hewitson coll.

d. Amboina, ♂.
e, f. Without locality, ♂, ♀.

25. C. ETESIPE GROUP.

145. CHARAXES CACUTHIS.

Charaxes cacuthis, *Hewitson, Exot. Butt.* iii. *Char.* pl. iii. figs. 12, 13 (1863).

a. Madagascar, ♂.

Hewitson coll.

b, c. Madagascar, ♂, ♀.
d. Without locality, ♂.

146. CHARAXES TAVETENSIS.

Charaxes tavetensis, *Rothschild, Novit. Zool.* i. p. 535 (1894).

Taveta, E. Africa.

Not in the Museum collection.

147. CHARAXES ETESIPE.

Nymphalis etesipe, *Godart, Enc. Méth.* ix. p. 355 (1823); *Butler, Trans. Ent. Soc.* 1869, p. 273, pl. v. figs. 5, 6.

Papilio etheocles, *Drury* (*not Cramer*), *Ill. Exot. Ent.* iii. pl. 10 (1782).

Nymphalis etheta, *Godart, Enc. Méth.* ix. p. 356 (1823).

a. Barombi, Cameroons (*Dr. Preuss*), ♂; from S. & G. coll.
b. Cameroons, ♂; from S. & G. coll.
c. Cameroons (*Druce coll.*), ♂; from S. & G. coll.
d. Cameroons, ♂.
e, f. West Africa, ♀ ♀; from S. & G. coll.
g–i. Isubu, ♂ ♂, ♀.
j, k. Old Calabar (*White*), ♂ ♂; from S. & G. coll.
l. Croboe district, Accra (*Hickling*), ♂.

m–o. Sierra Leone (*Dr. Preuss*), ♂ ♂, ♀.
p. Sierra Leone (*Crowley*), ♂.
q. Sierra Leone (*Barchard*), ♀.

Hewitson coll.
r–t. Sierra Leone, ♂ ♂, ♀.
u, v. Without locality, ♂, ♀.

This completes the species usually considered to belong to the genus *Charaxes.* In 1881, however, we received a species from Socotra having all the characters of *Charaxes* excepting the pattern (which is that of *Palla varanes* and allies). The supposed genus *Palla* differs no more from *Charaxes* than the various sections of the latter genus do from one another; the single tail to the secondaries is characteristic of females in the *C. mycerina* group.

26. C. VARANES GROUP.

148. CHARAXES BALFOURI.

Charaxes Balfouri, *Butler, Proc. Zool. Soc.* 1881, p. 176, pl. xviii. fig. 6.
Type, *a.* Socotra (*Prof. I. B. Balfour*).

149. CHARAXES VARANES.

Papilio varanes, *Cramer, Pap. Exot.* ii. pl. clx. D, E (1779).
a. Caffraria (*Druce coll.*), ♂; from S. & G. coll.
b. S. Africa (*Sir Andrew Smith*), ♀.
c. Natal (*Druce coll.*), ♀; from S. & G. coll.
d. Natal (*Shelley*), ♂; from S. & G. coll.
e. Natal (*Argent*), ♂.
f. Natal (*Gueinzius*), ♂.
g. Durban (*C. R. N. Burrows*), ♂.
h. Lake Mweru (*Crawshay*), ♂.
i, j. Central Africa (*Emin Pasha*), ♂.
k. British E. Africa (*Dr. Gregory*), ♂.
l. Lake Tanganyika (*C. Hore*), ♀.
m. Taita, East Africa (*J. A. Wray*), ♀.
n. Zomba (*Macclounie*), ♂.
o, p. Old Calabar (*J. W. Cockburn*), ♂.

Hewitson coll.
q, r. Natal, ♂, ♀.
s. Without locality, ♀.

150. Charaxes nigrescens.

Possibly a seasonal form of *C. fulvescens*; in some respects nearer to *C. varanes*, from which it differs in the yellowish basal area and blackish external area of the upper surface; the outer or submarginal row of spots reduced to points, the inner row small but sharply defined and ochreous; spots on disc of secondaries large and black: under surface pale greenish-yellow towards the base, all the markings strongly defined in black, the postmedian stripe dark and well defined, the first ocellus very black, the external bordering of the postmedian stripe very silvery, very metallic, not merely glaucous; external area more olivaceous than in *C. varanes* or *C. fulvescens*. Expanse of wings 90–98 millims.

Type, *a*. Sierra Leone (*Dr. Preuss*), ♂; from S. & G. coll.
b, *c*. Sierra Leone (*Barchard*), ♀, ♂.
d, *e*. Sierra Leone (*P. Crowley*), ♂, ♀.
f. Croboe district, Accra (*Higlett*), ♂.
g. Accra (*E. T. Carter*), ♂.
h. Ashanti, ♂.

Hewitson coll.
i. Gold Coast, ♂.

I should unhesitatingly have considered this to be distinct from *C. fulvescens*, but for the fact that Drury gives Sierra Leone as the locality from which his specimen (figured as *P. varanes*) was received.

151. Charaxes fulvescens.

Charaxes fulvescens, *Aurivillius, Ent. Tidskr.* xii. p. 216 (1891).
Papilio varanes, *Drury, Ill. Exot. Ins.* iii. p. 42, pl. 31. figs. 1, 2 (1782).
a. Barombi, Cameroons (*Dr. Preuss*), ♂; from S. & G. coll.
b. Victoria, Cameroons (*Druce coll.*), ♂; from S. & G. coll.
c. Congo (*Bates coll.*), ♂; from S. & G. coll.

Hewitson coll.
d. Without locality.

27. C. lichas Group.

152. Charaxes lichas.

Philognoma lichas, *Doubleday, Gen. Diurn. Lep.* pl. 49. fig. 3 (1850).
a–c. Ashanti, ♂ ♂, ♀.
d. Ashanti (*coll. Kaden*), ♂; from S. & G. coll.

e. Accra (*E. T. Carter*), ♂.
f. Croboe district, Accra (*Higlett*), ♂.
g. Barombi, Cameroons (*Dr. Preuss*), ♂; from S. & G. coll.
h, i. Old Calabar (*J. W. Cockburn*), ♂, ♀.
j, k. Angola (*Rogers*), ♂ ♂; from S. & G. coll.
l, m. Sierra Leone (*Dr. Preuss*), ♀, ♂; from S. & G. coll.
n. Sierra Leone (*Barchard*), ♂.

Hewitson coll.
o–q. Angola, ♂ ♂.
r. Cameroons, ♀.

153. Charaxes falcata.

Philognoma falcata, *Butler, Lepid. Exot.* p. 101, pl. xxxviii. fig. 1 (1872).

Types, *a–d.* Ashanti, ♂ ♂.
e. Old Calabar (*White*), ♂; from S. & G. coll.

This is a smaller, deeper coloured, more heavily black-bordered and shorter-tailed species than *C. paphianus*; it may be a seasonal form, for though we do not possess both from the same locality exactly, the range of *C. paphianus* would embrace that of *C. falcata.* I, however, am inclined to think that the latter is strictly a coast species of limited range.

154. Charaxes paphianus.

Charaxes paphianus, *Ward, Ent. Month. Mag.* viii. p. 120 (1871).

a. Sierra Leone (*Dr. Preuss*), ♂; from S. & G. coll.
b. Barombi, Cameroons (*Dr. Preuss*), ♂; from S. & G. coll.
c. Angola (*Rogers*), ♂; from S. & G. coll.

Hewitson coll.
d, e. Angola, ♂ ♂.

28. C. decius Group.

155. Charaxes violinitens.

Philognoma violinitens, *Crowley, Trans. Ent. Soc.* 1890, p. 554, pl. xviii. figs. 1, 2.

♂ Accra, ♀ Cameroons.

Hewitson coll. (as *P. decius*).
a. Old Calabar, ♀.

I think it open to question whether the sexes figured by Mr. Crowley actually belong to the same species, the female

being remarkably near to an Angolan insect of which we have both sexes; however, until females are received from Accra which as nearly resemble the male, the point cannot be decided.

156. CHARAXES CONIGER, sp. n.

Allied to *C. decius*, but the males with the white band much more broadly bordered with silvery-blue and extending to just below the median vein of secondaries, the orange-tawny patch which joins it at this point much brighter in colour and forming a well-defined cone, the outer edge of which is mottled with blackish and bounded by the third median branch; the tail, which is longer than in *C. decius*, is also tawny, but tipped with creamy-white; the submarginal ocellus in the radial interspace is isolated; the females resemble the insect figured as *C. violinitens* ♀, excepting in having a submarginal band of six hastate tawny (and a seventh nearly white, costal) spots on the primaries. In other respects this species agrees almost in every detail with *C. decius*.

Types, *a*, *b*. Old Calabar, ♂ ♂; from S. & G. coll.
c. Congo (*Bates coll.*), ♀; from S. & G. coll.
d. Angola (*Monteiro*), ♂; from S. & G. coll.

Hewitson coll. (as *C. decius*).
e, *f*. Angola, ♂, ♀.

It is just possible that this may be a seasonal form of *C. decius*, and *C. publius* a seasonal form of *C. Ussheri*; but only breeding can decide this.

157. CHARAXES DECIUS.

Papilio decius, *Cramer, Pap. Exot.* ii. pl. cxiv. A, B (1779).
a. Accra (*E. T. Carter*), ♂.
b. Croboe district, Accra (*Higlett*), ♂.
c. West Africa, ♀.
d, *e*. Ashanti, ♂ ♂.
f. Sierra Leone (*Rev. D. F. Morgan*), ♀.

Hewitson coll.
g. Without locality, ♂.

158. CHARAXES PUBLIUS.

Palla publius, *Staudinger, Deutsche ent. Zeit., Lep.* v. p. 267 (1892).
Philognoma rectifascia, *Weymer, Stett. ent. Zeit.* liii. p. 91 (1892).

a–c. Old Calabar (*White*), ♂ ♂, ♀; from S. & G. coll.
d. West Africa, ♀; from S. & G. coll.

Hewitson coll.

e. Angola, ♀.
f. Without locality, ♀.

159. CHARAXES USSHERI.

Philognoma Ussheri, *Butler, Trans. Ent. Soc.* 1870, p. 124; *Lep. Exot.* i. pl. xxi. fig. 3 (1871).

Nymphalis decius, *Lucas, Lep. Exot.* pl. lxiv. fig. 2 (1835).

a–c. Sierra Leone (*Dr. Preuss*), ♂ ♂, ♀; from S. & G. coll.
d, e. Sierra Leone (*Barchard*), ♂.
f. Sierra Leone (*P. Crowley*), ♂.
g. Sierra Leone (*Druce coll.*), ♂; from S. & G. coll.
h, i. Barombi, Cameroons (*Dr. Preuss*), ♂, ♀; from S. & G. coll.
j. Cameroons, ♂.
k, l. Old Calabar (*White*), ♂ ♂; from S. & G. coll.
m. Old Calabar, ♂.
n. Congo (*Bates coll.*), ♂; from S. & G. coll.
o. Dahomey (*Bates coll.*), ♀; from S. & G. coll.
p. Ashanti, ♀.

NOTE.—Since this paper was read, Dr. F. Moore has described and figured the following species, namely:—*Haridra Adamsoni*, Lepidopt. Indica, vol. ii. p. 236, pl. 173, and *Eulepis Wardii*, tom. cit. p. 262, pl. 188.—A. G. B., July 16, 1896.

On a remarkable use of Ants in Asia Minor.

By ROBERT MORTON MIDDLETON, Jr., F.L.S., F.Z.S.

[Read 6th February, 1896.]

I HAVE lately had the opportunity of making the acquaintance of Mr. Miltiades D. Issigonis, a Greek gentleman from Smyrna, now residing in London. Mr. Issigonis fell from his horse in Smyrna about six years ago, and received a severe but clean cut of an inch or rather more in length on the forehead above the right eye. In accordance with the custom of the country, he went to a Greek barber * to have the wound dressed, and the barber employed at least ten living ants to bite the two sides together. Pressing together the margins of the cut with the fingers of the left hand, he applied the insect by means of a pair of forceps held in the right hand. The mandibles of the ant were widely open for self-defence, and as the insect was carefully brought near to the wound, it seized upon the raised surface, penetrated the skin on both sides, and remained tenaciously fixed while the operator severed the head from the thorax, so leaving the mandibles grasping the wound. The same operation was repeated until about ten ants' heads were fixed on the wound, and left in position for three days or thereabouts, when the cut was healed and the heads removed. The ant employed is described by Mr. Issigonis as being about three-eighths of an inch long, very dark brown in colour, and of a particularly fierce disposition. Mr. Issigonis has kindly endeavoured to obtain the ants from Smyrna, and I hope that some may arrive ere long. We have together examined the specimens in the Natural History Museum, by the courtesy of Mr. W. F. Kirby, F.L.S., and Mr. Issigonis identified a rather large-headed *Camponotus* from India, not yet specifically named, as being nearer to the species in question than anything else in the National collection.

The only other observation of a similar nature hitherto recorded appears to have been that of Mons. Émile Mocquerys, of Rouen, who was in South America fifty or sixty years ago, and was elected a member of the Entomological Society of France in 1844. Sir John Lubbock, in his most valuable work on 'Ants, Bees, and Wasps,' says in chapter 5, with reference to ants generally:—"The tenacity with which they retain their hold on an enemy

* The barber-surgeons of the Levant still perform the old operations of blood-letting and cupping on English sailors for all sorts of ailments.

they have once seized is well known. M. Mocquerys even assures us that the Indians of Brazil made use of this quality in the case of wounds; causing an ant to bite the two lips of the cut and thus bring them together, after which they snip off the ant's head, which thus holds the lips together. He asserts that he has often seen natives with wounds in course of healing with the assistance of seven or eight ants' heads." *

The species which Mocquerys saw thus employed in Brazil was the well-known Saüba † or Umbrella-ant (now called *Atta cephalotes*, Linn.; the genus *Atta* being the creation of Fabricius). It is admirably described by Bates ‡, who truly speaks of the heads of the "worker-majors," one of the three forms of workers, as "enormously large, hard, and indestructible" §; he says, however, that these ants are "not very pugnacious" ‖. The Umbrella-ants are peculiar to Tropical America, *Atta cephalotes*, L., extending into Mexico.

It is remarkable that neither Wallace nor Bates should, apparently, have heard of the use of the Umbrella-ant as a substitute for the stitching-up of a wound; but it is still more extraordinary that Mocquerys' statement should be confirmed, after the lapse of so many years, by the discovery of the identical method among the Greek inhabitants of Asia Minor. Mr. Issigonis, who has unfortunately just telegraphed that he is unable to come to this meeting on account of indisposition, tells me that the operation is a frequent one in the vicinity of Smyrna, and is, to the best of his belief, practised by the Turks themselves as well as by the other nationalities found in Asiatic Turkey. Unfortunately, he can give no information as to whether this treatment of cuts is followed in Greece, European Turkey, or elsewhere.

* Ann. Soc. Ent. France, 2 sér., tom. ii. p. lxvii. The actual record is as follows, viz.:—"Bulletin Entomologique. Séance du 23 Octobre, 1844. Communications. M. Reiche donne, d'après M. É. Mocquerys, quelques détails sur une fourmi du genre Œcodome (*Œcodoma cephalotes*, Latr., *Formica cephalotes*, Linn.) * * * * * Les sauvages emploient la même espèce pour retenir rapprochés les bords d'une plaie; ils font mordre par cet insecte les deux bords de la plaie, puis leur arrachent l'abdomen et le thorax et ne laissent par conséquent que la tête, qui maintient ainsi les bords de la plaie rapprochés. Il n'est pas rare de voir des Brésiliens indigènes qui ont ainsi une plaie en voie de cicatrisation au moyen de sept ou huit têtes de cette fourmi."

† "Saüba" is the Indian name of this ant, and means, as Prof. Trail, F.R.S., kindly informs me, "the destroyer of the leaf."

‡ 'The Naturalist on the River Amazons,' pp. 23-33.

§ Page 31. ‖ Page 32.

On Segmentally disposed Thoracic Glands in the Larvæ of the Trichoptera. By GUSTAVE GILSON, Professor of Zoology at the University of Louvain. (Communicated by Prof. G. B. HOWES, Sec. Linn. Soc.)

[Read 5th March, 1896.]

IN the course of some researches on the silk-glands of the Trichoptera, my attention was attracted by a pointed prominence on the ventral face of the first thoracic segment of the larva.

This chitinous prominence looks very much like the spinneret of certain larval Lepidoptera, though it is usually a little longer than that. In fact it was taken for the spinneret by Réaumur *, who had not detected the very short spinning-tube on the labium. Recently Prof. Miall, in his excellent book on Aquatic Insects †, has recognized that the thoracic plug-like organ is not the spinning-tube (the labial spinneret being known to him). He does not attempt, however, to determine its use and true significance, but declares it to be an organ the function of which is as yet unknown.

A careful dissection of the ventral organs in the fore part of the body led me to the discovery of some very interesting glands, one of which is in connection with the afore-mentioned prothoracic prominence.

In *Phryganea grandis* each of the three thoracic segments bears one of these glands. All three are composed of two bundles of slightly moniliform tubules, lying, on each side, between the outer tunic and the body-wall (fig. 1).

The tubules of each bundle unite to form one main tube which passes obliquely towards the median line, where it joins its fellow of the opposite side to form a common duct. This, in the prothorax, is rather long; it enters the base of the cuticular prominence, at the tip of which it opens through a very tiny aperture. There is a small reservoir at the point of junction of the tubes.

The glands in the meso- and metathorax are almost identical in structure with that of the prothorax, being only a little smaller in size and having a smaller number of tubules. Their common duct is, however, extremely short and opens freely on the

* Réaumur, 'Mémoires pour servir à l'Histoire des Insectes.' Paris, 1734.

† Miall, 'The Natural History of Aquatic Insects,' p. 251. London, 1895.

ventral face, through a very small opening, no spinneret-like organ existing on these two segments. The aperture is extremely difficult to detect from the exterior, even with the help of good lenses, on account of its lying either inside or on the very edge of a deep cuticular fold.

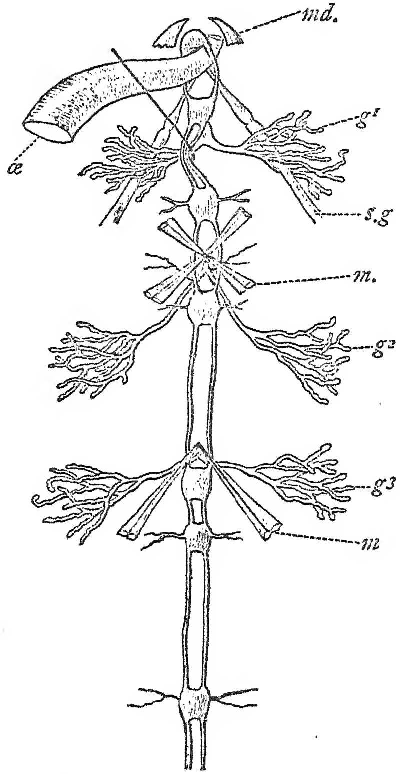


Fig. 1.—*Phryganea grandis.* Dissection (dorsal aspect).

g^1, g^2, g^3. Thoracic glands.
sg. Silk-gland.
m. Muscles.
œ. Œsophagus.
md. Mandibles.

In other species, for instance in *Limnophilus flavicornis*, the prothoracic gland is alone represented, and (*cf.* fig. 2) this single gland differs considerably from that of *Phryganea grandis.* It

consists of a single glandular tube, the inner part of which is composed of large gland-cells, the terminal part being a thin chitinous tube opening at the tip of a very long prominence similar to that of *Phryganea grandis*, between the two prothoracic legs.

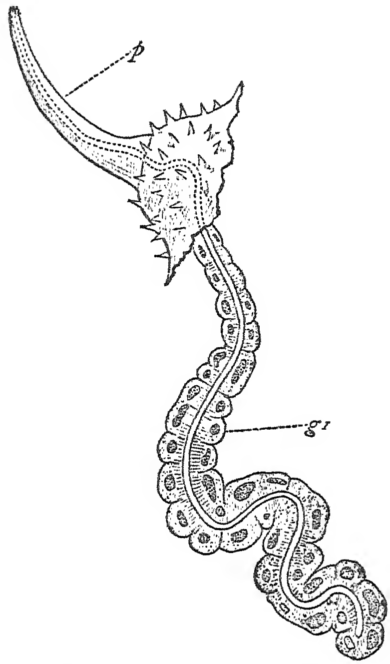


Fig. 2.—*Limnophilus flavicornis.*
Prothoracic gland (g^1) with a part of cuticle bearing the plug-like organ (p).

The meso- and metathorax contain no gland, and no trace of a prominence is to be seen on their ventral face.

The structure of the tubules is the same in all segments. The glandular epithelium consists of a small number of large cells, the central lumen being lined by a strong chitinous membrane. This cuticle, or so-called *intima*, is quite smooth and entirely devoid of pores or any kind of apertures through which the secretory product could be supposed to flow out of the cells. The presence of such a non-porous lining to a glandular tube is a remarkable feature of these organs, though not an unknown one amongst the Tracheata.

The secretion is not miscible with water, and presents the appearance of an oily fluid, though it is undoubtedly very different from a fatty substance in the chemical sense of the term.

These remarkable organs seem to deserve closer investigation and minute description. Being engaged in other work, I have asked one of my pupils, Dr. Henseval, to take up the subject. He will shortly publish a paper dealing with these glands and several others, as well as with the results of his researches on the chemical nature of the "oil" produced by the maxillary glands of *Cossus ligniperda* *, a substance which seems to be identical with that excreted by the thoracic glands of Trichoptera.

A peculiar interest attaches to these thoracic glands of the larval Trichoptera, in its possible bearing on the question of persistence of Annelidan features in the Tracheata.

That they are newly acquired or adaptive organs, arising in relation with the tubicolous habit, seems very unlikely, for if the mere utility of their oily product is sufficient to account for their appearance and development into important organs, there seems to me no reason why they should be segmentally repeated. One single gland, no matter where it lay, could furnish a suitable quantity of "oil" quite as well as the three moderately large glands lying in close proximity to one another but on separate segments.

There is an organ undoubtedly homologous with the thoracic glands of Trichoptera which has obviously nothing to do with tubicolous life, *i. e.* the ventral gland, "Bauchdrüse," described by Professors Poulton and Schäffer in certain non-tubiculous caterpillars.

It appears to me, therefore, much more probable that the thoracic glands are inherited organs; and that the aquatic and tubicolous habits of the larva may account for their preservation.

The question then presents itself, with which of the segmentally disposed organs of Annelids and *Peripatus* are the thoracic glands of Trichoptera to be considered homologous?

Only two kinds of organs may possibly be considered ancestral to these glands—the nephridia and the coxal glands. If the thoracic glands could be wholly or in part recognized as mesoblastic in origin, little doubt would remain as to their nephridial

* This paper was published during the passage of these pages through the printers' hands, under the title "Étude comparée des Glandes de Gilson," 'La Cellule,' tome ix. pp. 329-354.—Ed.

relationship. But this is not the case: nothing is known of the development of these till lately undiscovered organs. And if they were known to be epiblastic, as they probably are, it would not settle the question, as they could then be the remains of the outer part of the nephridia which so often originates as an epiblastic ingrowth, the mesoblastic or proper nephridial part having vanished in the course of evolution. No conclusion could be drawn against their nephridial relationships, whatever might be their origin. They appear to me, however, to be more likely nephridial than coxal, for the following reasons:—

1. They have no connection with the appendages. This fact, though not finally disposing of belief in their coxal nature, seems worth consideration, as no organ *undoubtedly coxal* is known to have moved far from the limb and met its fellow in the median line.

2. On the other hand, certain organs, the *nephridial* significance of which it is scarcely possible to doubt, unite in the median line and open there through one common aperture. Such are the so-called "salivary glands" of *Peripatus*. These are long tubes entirely disconnected in the embryo, and provided each with a funnel or nephrostome. Later on they lose their inner opening, and meet at the median line, just as the thoracic glands do in Trichoptera. The same is true of the disposition of the silk-glands of larval insects and, in many an adult form, of the true salivary glands, both being considered as modified nephridia.

3. There is a striking analogy between the arrangement of the tubules of the thoracic glands of Trichoptera and that of the Malpighian vessels generally. Both are derivatives of two chief tubes (at least this is the primitive disposition of the Malpighian vessels). These chief canals open in both cases through a single epiblastic ingrowth, and the common duct of the thoracic glands would thus appear to be equivalent in its relationships to the proctodæum. We have now much reason for regarding the Malpighian vessels as modified nephridia; and Gegenbaur's hypothesis that these vessels primitively opened on the surface of the body has received a strong confirmation from the fact, discovered by Wheeler *, that in *Doryphora* they early appear in the form of ingrowths from the walls of the proctodæum, while this

* Wheeler, "The Embryology of *Blatta germanica* and *Doryphora decemlineata*." 'Journal of Morphology,' vol. iii. 1889.

epiblastic invagination is still very shallow. Their nephridial significance, suggested already by their excretory function, is thus supported by serious morphological considerations.

The similarity of structure between the Malpighian nephridia and the glands here noticed seems thus to plead in favour of the nephridial character of the latter.

No trace of *segmentally repeated* organs, be they coxal or nephridial, has been hitherto detected, so far as I am aware, on the thoracic segments of the Hexapoda. Even in the lowest forms of insects (Thysanura), where remains of segmental organs, probably coxal, may be detected on all the abdominal segments *, no trace whatever of such organs is known on the thoracic, with the exception of the single "Bauchdrüse" in the prothorax of certain Lepidoptera, and some scent-glands in certain Hemiptera. It is thus worthy of remark that in Trichoptera each of the thoracic segments of the larva may possess a gland, and in its segmental repetition they reveal an ancestral character that could not be affixed with security to the single "Bauchdrüse" or to the scent-glands. There is thus possibly no segment of the Hexapod body left that can be said to be completely wanting in traces of segmental organs in some member of the group.

Conclusion.

1. In the larval Trichoptera each of the thoracic segments may be provided with more or less complex glandular organs more nearly representing nephridia than the coxal glands of Annelids and *Peripatus*. By the discovery of these it may now be said that:

2. In the Hexapoda remains of segmentally disposed glandular organs, be they coxal or nephridial, are known for the whole length of the body, from the mandibular to the posterior abdominal segments.

* Oudemans, 'Beiträge zur Kenntniss des Thysanuræ und Collembolæ,' Berlin, 1888.

The Larval Gills of the Odonata. By G. Gilson, Professor, and J. Sadones, Assistant, at the Zoological Institute of the University of Louvain. (Communicated by Prof. G. B. Howes, Sec. Linn. Soc.)

[Read 5th March, 1896.]

The rectal gills of *Libellula* and *Æschna* are well known to every student of comparative anatomy, and have attracted much attention since they were first discovered by Swammerdam. Chun's paper on the so-called "rectal glands" of Insects * is usually quoted as the most complete account of their structure. The works of our predecessors, however, have left room for new researches, and certain important physiological considerations remain unnoticed.

Wherever the respiratory organs of terrestrial Arthropods consist of numerous lamellæ enclosed in a recess or cavity, there is some structure present to prevent their adhering to one another, some provision for keeping open the spaces between these lamellæ, and allowing the air, or water, to freely bathe their surfaces. In the so-called lungs of spiders and scorpions, for instance, the lamellæ bear on one face at least numerous chitinous rods or ramified arborescent prominences †. We were, therefore, surprised not to find in the works of our predecessors any mention of the existence of such an apparently necessary mechanism in the Odonata. We soon discovered, however, that the gills of these insects are no exception to the rule. In *Libellula depressa* each lamella bears three conical pillars, two on one face and one on the other (fig. 1). The use of these pillars is obviously the same as that of the prominences of the Arachnidan lung; but, while the latter are only cuticular and merely more or less complex thickenings of that layer, the pillars of Odonata are outgrowths of the cuticle, followed by the subcuticular layer and containing several nuclei.

The gill of *Libellula* and *Æschna* is a leaf-like folding of the proctodæal epithelium and cuticle. The space between the two laminæ contains the main tracheal trunks. These divide very

* Chun, "Ueber den Bau die Entwickelung und physiologischen Bedeutung der Rectaldrüsen bei den Insekten." Abhandl. der Senckenb. naturf. Gesel., 10 Bd., 1876.

† See L. Berteaux, "Le Poumon des Arachnides." 'La Cellule,' tom. v. fasc. 2.

soon into a bundle of very fine tubes that neither divide again nor end freely, as is the case in other organs, but bend into a series of very long, curved, intra-lamellar loops. These loops, running parallel to the surface of the gill, reunite to form other main trunks which shortly leave the lamella and open into some branch of *the same* main tracheal tube that gives off the original trunks from which they are derived (fig. 2). As this is so, the

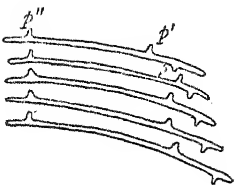


Fig. 1.

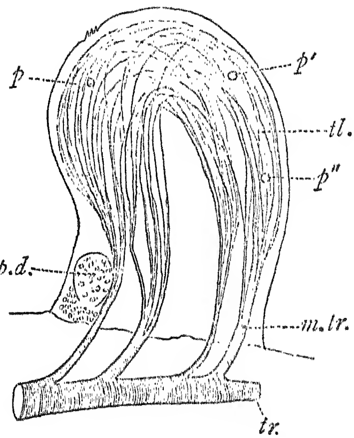


Fig. 2.

Libellula depressa.

Fig. 1.—Schematic sections through five larval gills. *p*, *p'*, *p''*, pillars.
Fig. 2.—Surface view of one gill. *p*, *p'*, *p''*, pillars. *tl.*, tracheal loops. *m.tr.*, main tracheal tubes. *tr.*, external tracheal trunk. *ep.d.*, epithelial disc.

air would not appear to circulate regularly through the system of tracheal loops, as might be supposed to be the case if the main lamellar trunks were branches of larger tubes coming from different parts of the body. The contents of the loops must be renewed, if at all, by some special mechanism, but we do not here propose to further investigate this point.

The tracheal loops, which evidently constitute the functional part of the system, do not hang freely in the space between the two laminæ: they enter the subcuticular layer and run their whole length through it, usually not in contact with the outer cuticle (fig. 3).

The subcuticular layer is a syncytium in which no cell-boundaries can be detected. It contains two kinds of nuclei, and

seems to be the result of the association and complete fusion of two distinct elements—the subcuticular epithelium and the tracheal cells.

As before remarked, the gills contain an intralamellar cavity in which the tracheal tubes are lying. The existence of this cavity was not easily observable, as the two plates of the

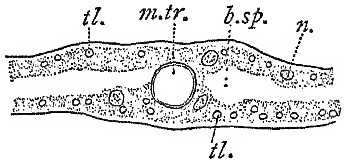


Fig. 3.—Part of section through a rectal gill.
tl., tracheal loops within the subcuticular layer. *m.tr.*, main tracheal tube. *b.sp.*, blood-space. *n.*, nucleus.

lamella, in sections of hardened objects, are usually found sticking tightly to each other. We endeavoured to determine its limitations by cautiously injecting Indian ink into the "body-cavity." The black particles were found between the two plates up to the free edge. The existence of the cavity may, however, be sometimes detected without any injection, and, even when the plates are in contact, blood-cells are sometimes noticeable between them. There is, therefore, not the slightest question about the existence of an intralamellar cavity communicating with the cœlom, and the presence of blood in the gill cannot be doubted. The necessity for definitely establishing these points is sufficient when it is remembered that the process of respiration would appear to be very different in a "bloodless" gill from what it is in an organ supplied with an elaborate blood-system.

The tracheal loops of the gill were known to Leydig, and were first described by Oustalet *. But no one, so far as we know, has ever noticed that they are enclosed within the protoplasmic layer. Such gaseous interchange as takes place between the contents of the tracheal loops and the exterior must first involve this protoplasmic layer; and this fact appears to us important in its bearings on the conclusion now gaining ground, that

* Oustalet, "Mémoire sur la respiration des larves des Libellules." Ann. Sci. Nat. sér. 5, Zoologie, tom. 11 (1869).

the absorption of oxygen is not a mere physical process but a more complex one, in which the living protoplasm plays an active part. It has been experimentally shown that the death of the epithelial cells causes a striking change in the action of an organ functioning, during life, as an osmotic divider between two different liquids or gases. As Professor Miall very rightly remarks, the first setting up of the process in young larvæ, when small bubbles of gas appear in the liquid that fills the tracheal tubes, cannot possibly be explained as a mere physical phenomenon. Whatever may be the mechanism of respiration, it is a process much more intricate than the play of an ordinary osmotic apparatus; a process that deserves the term "vital," which we are wont to apply to complex activities, the actual workings of which escape our observation. The living protoplasm is the agent of absorption and setting free of the oxygen as well as of the emission of carbonic acid.

No wonder, therefore, that in the gills of Odonata the functional air-tubes are completely imbedded in the protoplasm of the subcuticular layer. And, as regards the absorption of oxygen, there is no wonder that no special mechanism is provided to renew or to remove the contents of the tracheal loops. If the oxygen extracted from the surrounding water is actively discharged into the tracheal cavity by the protoplasm, and a stream of gas is continually blown out of the loops into the general tracheal system, no external mechanism is wanted to clear out the gaseous contents of the gill and transmit the oxygen to the other parts of the body.

As regards the emission of carbonic acid a difficulty arises; for if the function of the gill be to excrete the carbonic acid as well as to absorb the oxygen, it seems likely that the former must be carried to the organ by some mechanism. If the tracheal tubes furnished the only apparatus through which the carbonic acid could be carried, it seems that a "propelling" mechanism, though unnecessary as regards oxygen, would be required. But this is not the case. Carbonic acid is carried away from the organs *by the blood* and the blood-system enters the gills, as we have said before. There it may be directly absorbed and ejected by the subcuticular layer without ever entering the functional part of the tracheal system. The only objection to this view is that the blood is not very abundant in the gill, and that no special mechanism is known to make it circulate through the organ.

We hope to show in a subsequent paper, however, that the existence of such a mechanism is quite possible though it cannot be very efficient. Being thus led to enquire whether there are no other organs to help in the excretory activity of the gill, we have discovered, and intend soon to describe more fully, two very remarkable and quite enigmatical organs in a part of the digestive tract, which we propose to term the *prærectal vesicle.*

The organs in question consist of two discs of very peculiar epithelial cells which depend from the wall of this vesicle. They appear to be non-glandular, and their function is quite unknown. We have on several occasions found the prærectal vesicle filled up and considerably swollen by a gaseous contents, and we incline to the belief that the function of the "discs," as well as of other productions in the basal part of the gill which are covered with the same epithelium, may be the excretion of carbonic acid, but we put this forward merely as a hypothesis, pending experimental research on the subject.

In all non-tracheal gills, as well as in Arachnidan lungs, the blood plays a very important part indeed in the process of respiration—that of collecting and carrying away the oxygen to all parts of the body. The osmotic process, on current theory, is supposed to take place between the outer atmosphere or water and the blood itself, through the cellular and cuticular wall. Now, if there is a blood-space in the gill of *Libellula*, it may be thought likely that the same process must take place there, just as in the gills of *Limulus* and *Isopods*, or in the lungs of spiders, because the same causes must produce similar effects under similar circumstances, and a certain foundation cannot be refused this hypothesis. We may remark, however, that the circumstances are not exactly the same in tracheal and non-tracheal organs. The presence of numerous tracheal loops in the protoplasmic coating of the gill may alter considerably the conditions of the process, and it could alter them even if it were a mere physical one. But, knowing that this respiratory process is neither so clear nor so simple as it is often said to be, we cannot refrain from thinking that the functional protoplasm casts the greatest part of the absorbed oxygen, if not the whole of it, into the tracheal tubes that must carry it to every organ in the body, and that the blood would seem to play a very unimportant part, if any, in the absorption of that gas. On the other hand, it must

play a very important part in the excretion of carbonic acid, for it has been shown before, and it should not be forgotten, that its function in the gill is largely that of nourishing the tissues.

To recapitulate:—

1. The rectal tracheal gills of larval Odonata are prevented from adhering to one another by the presence of three conical pillars.
2. The main tracheal tubes alone are lodged between the two plates that form the gill; the terminal loops, *i. e.* the functional parts of the system, run *within* the protoplasm of the subcuticular layer.
3. A blood-space communicating with the "body-cavity" exists in the rectal gills.
4. The oxygen seems to be absorbed through the tracheal loops by the action of the subcuticular protoplasm only, and to be discharged from these into the general tracheal system.
5. Carbonic acid, on the contrary, appears not to be carried to the gills by the tracheal tubes but by the blood alone, certain enigmatical organs borne upon a "prærectal vesicle" being perhaps directly concerned in its excretion.
6. In any case the blood would appear to play an important part in the excretion of carbonic acid, and a very unimportant one in the absorption of oxygen.

On two little-known Opisthoglyphous Snakes. By G. S. West, A.R.C.S., Scholar of St. John's College, Cambridge. (Communicated by Prof. G. B. Howes, Sec. Linn. Soc.)

[Read 19th March, 1896.]

(Plate XVIII.)

Having been recently engaged at the Royal College of Science, London, in an investigation of the buccal apparatus of the opisthoglyphous ophidians *, there were forwarded to me a few months ago by Prof. Howes a couple of snakes, and with them a note asking me to examine their buccal characters. At the same time I also received a letter from Mr. G. A. Boulenger asking me to clear up as much as I was able with regard to their glands and teeth. One of the snakes was an *Erythrolamprus*, and the other an animal about which there was a doubt as to whether it was an aglyphous variety of *Erythrolamprus* or some other snake. The latter was one of three specimens from Nicaragua, all of which were aglyphous, which had been regarded as an aglyphous variety of *Erythrolamprus* by Dr. Günther †. In external features and coloration the snakes were absolutely identical, but if their dentition and buccal characters differed, it was possible, as suggested by Mr. Boulenger, that the aglyphous one might belong to a genus closely allied to *Liophis*.

The following is a description of the glands and teeth of the first snake, viz. :—

Erythrolamprus Æsculapii, *Günth.*

The *poison-gland* (fig. 1 *g.p.*) is a large pear-shaped mass having a slight sigmoid curve; its anterior pointed end is situated under the eye, and its posterior end reaches almost to the articulation of the mandible. It exhibits a marked lobulation, the lobules being arranged in series converging towards the central duct, which leaves the gland at about the middle of its ventro-internal face and passes in a slightly forward direction to the base of the first grooved tooth.

As in other opisthoglyphous snakes, the poison-gland is not

* *Cf.* P. Z. S. 1895, pp. 812–826.

† Biol. Centrali-Americ., Part cxxi. p. 166.

enveloped in any capsule of strong fibrous tissue, but is only held in position by an attachment of fibrous connective tissue along its inner surface. The alveoli of the poison-glands of all the snakes of this group have only small cavities and can hold but little of the secretion. There are no muscles related in any way to the gland *, and therefore the secretion which finds its way to the grooved teeth—and this can be but small in quantity—must do so by the pressure of the bite alone. The gland more or less overhangs the grooved teeth in most genera, and as the latter do not come into use unless the snake has obtained a very firm bite, it is evident that under these circumstances the pressure on the gland will be considerable and will suffice to propel the poison through the comparatively short duct to the teeth.

The *superior labial gland* consists of two distinct and isolated portions. The anterior part (*g.l.'*) is composed of a series of somewhat irregular lobules, slightly embracing the anterior end of the poison-gland behind and reaching as far forwards as the nostril; the posterior portion (*g.l.''*) is very small and consists of a few lobules situated in the ventral hollow of the poison-gland near its hinder end.

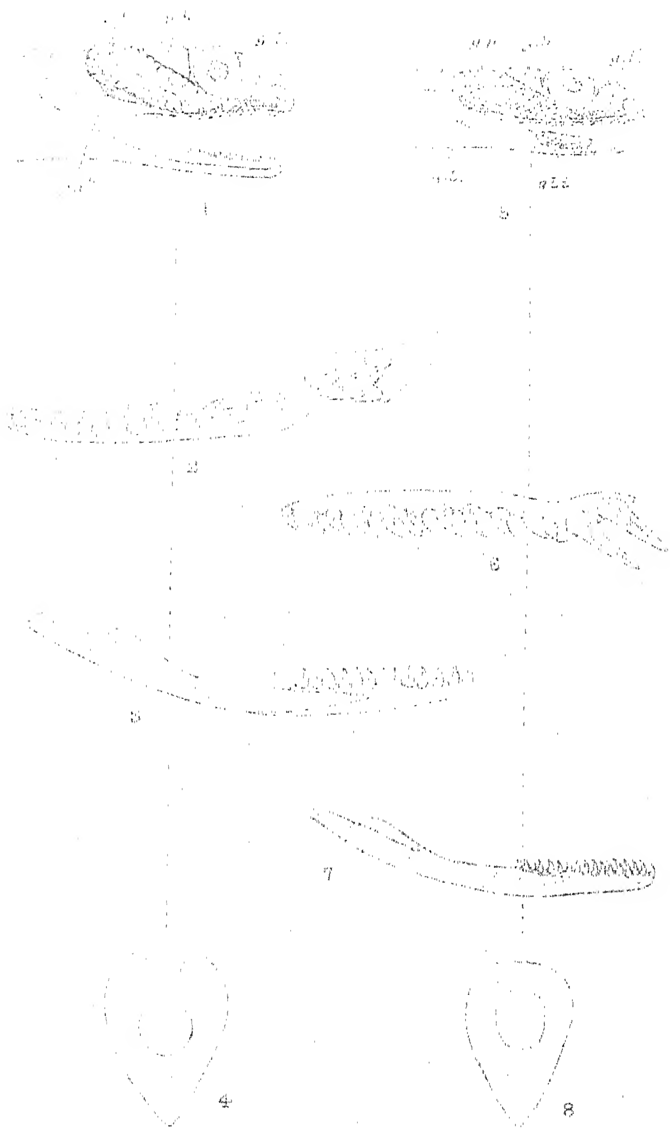
The *inferior labial gland* extends along the greater part of the outer side of the mandible.

The *Harderian gland* (*g.h.*) is visible, on removing the skin, as a glandular mass of considerable size posterior to the eye, partially covered by the poison-gland.

The *maxilla* (fig. 2) possesses in all 12 teeth. The 10 anterior teeth, which are in a uniform series, are short, thick, and much curved, and they slightly increase in size towards the hinder end of the maxilla. The two posterior teeth are larger, almost straight, and directed backwards at a much greater angle than the others. On their anterior face they possess a shallow,

* In the Hydrophiinæ (marine snakes) there are no muscles connected with the poison-gland in *Distira cyanocincta*, *Enhydris Hardwickii*, or *Platurus fasciatus*, but in *Hydrus platurus* the gland is in relation with the masseter muscle.

C. J. Martin, "Snakes, Snake-poison, and Snake-bites," Journ. Sydney Univ. Medical Soc. vol. i. no. 2 (Hermes Med. Suppl.), remarks, p. xix, that "the fang, except in sea-snakes, is a functional tube." I find the fangs of sea-snakes to possess a closed groove quite as functional as that of the fang of an Elapine or Viperine snake.



widely open groove (*vide* fig. 4), and on their posterior face there is developed a cutting-edge.

The *mandibular teeth* are 16 in number, very small and upright, and set in a compact series with a slight increase in size anteriorly.

Now with regard to the second snake, viz.:—

? Aglyphous variety of *Erythrolamprus*, Günther.
[? *Liophis*, Boulenger.]

The buccal glands of this snake (*cf.* fig. 5) are precisely identical with those of *Erythrolamprus*, excepting that the inferior labial gland (fig. 5, *g.l.i.*) is not quite so extensive.

The mandibular teeth (*cf.* fig. 7) are precisely like those of *Erythrolamprus*, very small, closely set, and 17 in number.

There are the same number of maxillary teeth, viz., 12. The 10 anterior teeth are identical in form and disposition with the corresponding ones in *Erythrolamprus*, and the 2 posterior enlarged teeth only differ from the corresponding teeth in the latter genus *in the entire absence of a groove* (*vide* fig. 8). In fact, this is the only character which in any way distinguishes the buccal apparatus of these two snakes.

Hence this animal is nothing more nor less than an *aglyphous variety* of *Erythrolamprus, i. e.* of an "opisthoglyphous" snake.

This snake is famous for having bitten Mr. Quelch, the Curator of the Georgetown Museum, and for having led him* to a belief in "the venomous action of the secretion of harmless snakes." The facts concerning it herein dealt with have a special interest in their bearings on recent classification †, and in consideration of the experimental work of Phisalix and Bertrand ‡ and others, of the recent discovery of a Burmese snake § having the loreal shield of a supposed harmless Colubrine and the poison apparatus of a viper, and, last but not least, of the existence of an individual of *Distira cyanocincta* with grooved mandibular teeth ‖.

* J. J. Quelch, 'Venom in Harmless Snakes,' Zool. (3) xvii. 1893, p. 30.

† *Cf.* Boulenger, 'Fauna of British India—Rept. and Batrachia,' p. 277.

‡ *Cf.* especially Phisalix and Bertrand, Compt. Rend. tom. 118, p. 76.

§ *Azemiops Feæ*, Boulenger, P. Z. S. 1888, p. 266.

‖ *Cf.* P. Z. S. 1890, p. 618.

EXPLANATION OF PLATE XVIII.

Fig. 1. *Erythrolamprus Æsculapii*, Günth. Head from right side. The inferior labial gland is removed.
2. " " Right maxilla from below, × 8.
3. " " Right mandible.
4. " " Transverse section of posterior maxillary tooth.
5. Aglyphous variety of *Erythrolamprus Æsculapii*. Head from right side.
6. " " " Left maxilla from below, × 8.
7. " " " Right mandible.
8. " " " Transverse section of posterior maxillary tooth.

Reference letters.

g.h. Harderian gland.
g.l'. } *gl.''.* } Supra-labial gland.
g.l.i. Infra-labial gland.
g.p. Parotid (Poison) gland.

On some Exotic Fossorial Hymenoptera in the Collection of the British Museum, with Descriptions of New Species and of a New Genus of the *Pompilidæ*. By Lt.-Col. C. T. Bingham, F.Z.S., F.E.S. (Communicated by W. F. Kirby, F.L.S.)

[Read 2nd April, 1896.]

(Plate XIX.)

While engaged in incorporating accessions and rearranging the collection of the *Pompilidæ* and other Fossorial Hymenoptera in the Museum of Natural History at South Kensington, I have found a number of species which, so far as I can make out, have not previously been described. In the classification of the *Pompilidæ* I have in this paper followed Kohl. His "Die Gattungen der Pompiliden," published in the Verhandlungen der k.-k. zoologisch-botanischen Gesellschaft in Wien, 1884, contains by far the best arrangement of the genera of that very difficult and puzzling family.

Genus Myzine, *Latr.*

Myzine dimidiaticornis, sp. nov.

♂. Head, thorax, and abdomen punctured, the punctures dense and coarse on the front of the face above the antennæ, on the sides of the thorax, mesonotum, and median segment above, more distant and finer on the vertex, the back of the head, the pronotum, and abdomen; clypeus constricted vertically, transverse; the mandibles smooth; the antennæ porrect and thickened; the pronotum long, constricted anteriorly; mesonotum and median segment coarsely cribrate, the latter truncated at apex, the truncation punctured, an irregular central longitudinal carina from its base to the margin of the truncation; legs smooth, with a few distant punctures, and slightly pubescent; abdomen long, the base of the segments constricted, the apex below with a strong recurved spine. Intensely black; the clypeus, scape of the antennæ, and the basal four joints of the flagellum above and below dark ferruginous red; abdomen with prismatic tints of blue and purple. Wings—the fore wing clear hyaline at base up to the basal nervure, fuscous beyond, with a superb purple effulgence; hind wing fuscescent at apex, becoming gradually hyaline at base.

♂. Length 13 millim.; exp. 22 millim.

Hab. Kumaon, N. India.

It somewhat resembles *M. dimidiata*, Smith, in the colour of the wings, but that species has the median segment rounded posteriorly, and the basal segment of the abdomen petiolate and markedly constricted at apex, besides being totally black in colour.

Genus Scolia, *Fabr.*

Discolia, *Sauss.—With 2 cubital cells and one recurrent nervure.*

Scolia sikkimensis, sp. nov.

♀. Head smooth, thorax and abdomen punctured and pubescent; clypeus with its anterior margin slightly arched and a row of coarse submarginal punctures; antennal ridge short, with a shallow abbreviated groove above it; mesonotum in the middle and the apex of the scutellum smooth and shining; median segment short posteriorly, roundly truncate, the truncation slightly convex; abdomen longer than the head and thorax, the basal segment tuberculated in the middle above, the 2nd segment constricted at base. Black, the pubescence fulvous red; the mandibles, the scape, and the 1st joint of the flagellum

of the antennæ, the vertex and cheeks behind the eyes, the posterior lateral angles of the median segment, a spot on each side of the basal segment of the abdomen, and a broad band at the base of the 2nd and 3rd segments above, yellow; the band on the 2nd segment is deeply emarginate at the sides, that on the 3rd segment is notched in the middle at base. Wings flavo-hyaline, ferruginous along the costal margin, with a long fuscous spot beyond the apex of the 2nd cubital cell.

♂. Similar, but has in addition the clypeus, the pronotum, the mesopleuræ, the tegulæ, a lateral longitudinal line on the mesonotum above the tegulæ, the scutellum and postscutellum, a band at the apex of the 4th abdominal segment, a lateral spot on the 2nd and 4th, and a band on the 3rd ventral segment, yellow; the coxæ, femora, and tibiæ of the legs are also variegated with yellow; the antennæ, the vertex of the head, and the intermediate and posterior tibiæ and tarsi are black.

♀. Length 22–25 millim.; exp. 44–48 millim.

♂. Length 18–22 millim.; exp. 40–45 millim.

Hab. Sikkim.

Closely allied to *S. histrionica*, Fabr., but differs considerably in markings, and above all in the puncturing of the thorax and the shape of the basal abdominal segment.

SCOLIA DESIDIOSA, sp. nov.

♀. Closely resembles *S. decorata*, Burm., but is smaller, and the sculpture and markings are very different. Clypeus transverse, a little convex in the middle, the margins closely punctured, the vertex and front somewhat coarsely punctured, the thorax finely and distantly, the mesonotum more closely punctured; the abdomen is smooth, with only a few scattered punctures, the pubescence thin and sparse. Black; two spots above the base of the antennæ, the sides of the pronotum, a spot under the base of the wings, the scutellum, two lateral spots on the postscutellum, the posterior angles of the median segment, and large oblong maculæ on the sides of the basal four segments of the abdomen, yellow; the maculæ on the 2nd segment have a large black spot at their base below. Wings fusco-hyaline, with a dark subapical cloud at the apex of the fore wing.

♀. Length 22–25 millim.; exp. 38–40 millim.

♂. Length 14–16 millim.; exp. 40–44 millim.

Hab. Sikkim; Tenasserim.

Scolia floridula, sp. nov.

♀. Closely resembles *S. sikkimensis*, but differs in sculpture and markings. The clypeus is raised in the centre, almost tuberculate, the thorax and abdomen more coarsely and closely punctured, and the basal segment of the latter is not tuberculate at base. Black; a crescentic mark on the clypeus, the front of the face above the antennæ and as high as the anterior ocellus, a line on the occiput prolonged behind the eyes, the pronotum, a spot under the base of the wings, the scutellum, a line on the postscutellum, two small lateral spots on the basal segment of the abdomen, two larger lateral spots on the 2nd segment, and a broad band at the base of the 3rd segment, yellow; the wings flavo-hyaline, dark ferruginous along the costal margin, becoming fusco-ferruginous at the apex; legs ferruginous, the anterior pair variegated with yellow, the tarsi nigro-fuscous.

♀. Length 18 millim.; exp. 34 millim.

Hab. Tenasserim.

Genus Ceropales, *Latr.*

Ceropales pernix, sp. nov.

♂. Head, thorax, and abdomen smooth, slightly shining; clypeus large, its anterior margin widely emarginate; labrum exserted, the apex emarginate; pronotum short, its posterior margin arched; mesonotum subconvex, with two longitudinally parallel, abbreviated, shallow furrows at the apex; scutellum and postscutellum large, not laterally compressed; median segment with a rounded slope posteriorly; legs long, smooth, the claws of the tarsi stout, but apparently without a tooth below at base. Wings—the cubital and discoidal nervures of the fore wing both reach the margin of the wing, the basal nervure interstitial, the 2nd and 3rd discoidal cells subequal. Ferruginous yellow, the mandibles except at apex, the labrum, palpi, clypeus, sides and front of face, a line behind the eyes, and the posterior margin of the pronotum, light straw-yellow; the abdomen, which is short, has the posterior margins of the 1st to 5th segments above dull yellow.

♂. Length 9 millim.; exp. 14 millim.

Hab. Tenasserim.

A distinct little species.

Genus PSEUDAGENIA, *Kohl.*

PSEUDAGENIA RAVA, sp. nov.

♀. Pruinose; the clypeus short, its anterior margin rounded and bearing an obscure transverse carina, front sub-convex; the ocelli placed in shallow pits, an impressed vertical line from the anterior ocellus to between the bases of the antennæ; head transverse posteriorly; pronotum rather long, rounded anteriorly, its posterior margin very slightly arched; median segment with a rounded, rather steep slope posteriorly, feebly transversely striated; legs long, the tibiæ and tarsi smooth or with a few minute spines, claws unidentate; abdomen fusiform, curved, the petiole short, the ventral furrow well-marked. Black, with dense grey pile which appears silvery in certain lights, and on the posterior margins of the segments of the abdomen forms silvery bands, that on the third segment being broadest and produced angularly forward in the middle; wings flavo-hyaline, the apical margins broadly fuscous.

♀. Length 10 millim.; exp. 18 millim.

Hab. Bangalore, S. India.

Distantly resembles *Pseudagenia novaræ*, Sauss., from Australia, but that species is larger, has the antennæ yellow, and the wings fuscous.

PSEUDAGENIA ERIGONE, sp. nov. (Pl. XIX. fig. 1, ♀.)

♀. Head and thorax rugose; abdomen smooth and shining. Head and pronotum very finely and closely punctured; mesonotum, scutellum and postscutellum longitudinally, the median segment transversely, and the pleuræ obliquely striated, the striæ very fine on the mesonotum and pleuræ and coarse on the scutellum, postscutellum, and median segment; legs smooth, with extremely minute spines on the tibiæ and on the tarsi beneath, claws bifid abdomen petiolate, the 2nd ventral segment with a deep transverse furrow. Black, the head and thorax except the scutellum opaque, the latter and the abdomen shining ebony-black; wings hyaline, with two fuscous transverse fasciæ, the first at the basal nervure very broad, and reaching from the costal to the anal margin of the fore wing, the second narrow, occupying the basal angle of the radial and the apices of the 2nd cubital and 2nd discoidal cells.

♂ unknown.

♀. Length 13 millim.; exp. 27 millim.

Hab. Tenasserim.

A very distinct species, unlike any other in the sculpture of the thorax and in having the fascia on the wing, close to the base, broader than the subapical fascia.

PSEUDAGENIA ARTEMIS, sp. nov. (Pl. XIX. fig. 2, ♀.)

♀. Head, pro- and mesonotum, scutellum and postscutellum, and abdomen smooth and shining; median segment transversely, and the pleuræ obliquely striate; clypeus convex, its anterior margin obtusely angular; median segment with a rounded steep slope to its apex; legs long, the intermediate and posterior tibiæ and tarsi with very minute spines, almost smooth, claws with an obtuse strong tooth at base below; abdomen with the basal segment less petiolate than in most other species of the genus. Dark cobalt-blue; the antennæ, the femora, tibiæ, and tarsi of the legs opaque black; the fore wing dark fuscous with a purple effulgence, the hind wing hyaline at base, lightly fuscous towards the apex; nervures and tegulæ piceous black; the face in front, the sides of the thorax, and the median segment covered with a thin soft silvery-white pubescence.

♂ unknown.

♀. Length 19 millim.; exp. 41 millim.

Hab. Tenasserim (Salween Valley).

Resembles somewhat the description, so far as it goes, of Lepeletier's *Pallosoma cyanea*, but that species is described as having bluish-black pubescence and the wings "sans transparence."

PSEUDAGENIA CLYPEATA, sp. nov.

♀. Pruinose; the pronotum very short, its anterior margin nearly transverse, the posterior angularly arched; median segment with a rounded, somewhat steep slope to its apex, and a broad shallow longitudinal sulcation down the middle; legs with the tibiæ and tarsi with very minute spines, nearly smooth, claws minutely unidentate; abdomen petiolated, the 2nd ventral segment with a deeply impressed transverse furrow. Black, with a dense soft white pruinosity giving it a greyish look; clypeus yellowish white, with a minute black spot in the middle at base; the anterior tibiæ and tarsi and the flagellum of the antennæ below, with three or four of the apical joints above, testaceous red; the extreme apex of the intermediate femora, with the underside of the tibiæ and tarsi, and the posterior femora blood-red;

wings hyaline, somewhat iridescent, the nervures and tegulæ testaceous brown.

♂ similar, but has the femora, tibiæ, and tarsi of the anterior legs and the posterior four femora testaceous red.

♀. Length 9–11 millim.; exp. 20–24 millim.

♂. Length 6–8 millim.; exp. 13–17 millim.

Hab. Generally distributed throughout Burma and Tenasserim.

Resembles *Pseudagenia tincta* and *mutabilis* of Smith, and *P. ariel*, Cameron, but differs in the abbreviated prothorax and the colouring of the clypeus, antennæ, and legs, which is very constant in this species.

PSEUDAGENIA STULTA, sp. nov.

♀. Head and thorax pruinose; abdomen smooth, polished and shining; clypeus narrow, almost transverse, its anterior margin smooth and shining, arched, and produced a little in the middle; the front above the antennæ, the vertex, pro- and mesonotum finely punctured, the punctures distant on the head and pronotum, somewhat closer together on the mesonotum; the front subconvex; the pronotum transverse anteriorly, with the shoulders prominent, almost tuberculate, posteriorly arched; mesonotum with a central longitudinal carina at apex; scutellum broad, postscutellum rounded, not laterally compressed; median segment long, with a regular slope to its apex, transversely striated, a central longitudinal broad furrow at base and apex, interrupted in the middle; legs long, the tibiæ and tarsi smooth, without spines, claws unidentate; abdomen as long as the head and thorax together, the 2nd ventral segment with a transverse furrow; the fore wing with the basal nervure not interstitial, the hind wing with the cubital nervure rising well after the apex of the anal cell. Head and thorax opaque dull black, covered with a silky silvery pile, most dense on the face in front and at the apex of the median segment; the apical three or four joints of the antennæ and the coxæ and trochanters of the legs testaceous brown, the tibiæ and tarsi black; the abdomen shining black; wings hyaline, beautifully iridescent.

♀. Length 11 millim.; exp. 20 millim.

Hab. Tenasserim.

This pretty little species resembles *Pseudagenia tincta* and *mutabilis*, Smith,* but differs in being longer and slighter, in the pronotum not being rounded but transverse in front with prominent angles at the sides, in the metanotum being transversely

striated, and in the colour of the coxæ and trochanters of the legs, which in the others are black. From *Pseudagenia ariel*, Cameron, it differs in not having the mandibles rugose, in the shape of the prothorax, and in the colour of the legs and wings.

PARAGENIA, gen. nov.

Allied to *Agenia*, Schiödte, and *Pseudagenia*, Kohl; differs in the body being more slender and the legs longer in proportion, in the coxæ and femora of the legs being thickened as in the genus *Macromeris*, particularly so in the male, which has, further, the coxæ of the intermediate legs produced in front into large, remarkably prominent cone-shaped tubercles. In both sexes the joints of the anterior tarsi are extremely attenuated at base. The neuration of the wings is similar to that of *Pseudagenia*, the species of which genus the type and only known species of *Paragenia* resembles in its breeding-habits, making cone-shaped nests of clay and filling them with spiders.

PARAGENIA ARGENTIFRONS. (Pl. XIX. figs. 3, 3*a*.)

Macromeris argentifrons, Smith, Journ. Linn. Soc. ii. (1858), p. 97. 2, ♀ ♂; id. xi. (1867) p. 356. 2; Cam. Mem. Manch. Lit. & Phil. Soc. 1891, p. 436. 3.

Hab. Borneo; Malacca; Java. Common in Burma and Tenasserim, and in Sikkim.

I have a long series of this species, which I have compared carefully with the types in the British Museum. Smith placed it under Lepeletier's genus *Macromeris*, probably because of the swollen coxæ and femora in the male; but it cannot be classed under that genus, as the fore wing has the radial cell acuminate, not rounded, at apex, the tibiæ and tarsi are spinose, and there is no lateral tubercle *on the thorax* in front of the intermediate coxæ.

Genus POMPILUS, *Fabr.*

POMPILUS DÆDALUS, sp. nov.

♀. Head, thorax, and abdomen smooth and shining; clypeus convex, subtriangular, its anterior margin very slightly arched, nearly transverse; the inner margin of the eyes with an outward curve; the front sulcated from the anterior ocellus to between the base of the antennæ; the back of the head transverse; the mesonotum with the sides raised and a short longitudinal furrow on either side; the scutellum prominent; the median

segment short and truncated at the apex, the truncation obscurely transversely striated; legs stout, spinose, claws bifid; abdomen sessile, obscurely pruinose. Head, thorax, and abdomen black, the antennæ and the tibiæ and tarsi of all the legs dull piceous red; wings fuscous, with little or no effulgence, the apex of the radial cell acutely angled, the 2nd and 3rd cubital cells subequal; abdomen with the posterior margins of the segments narrowly testaceous.

♀. Length 15–19 millim.; exp. 28–36 millim.

Hab. Sikkim; Tenasserim.

The only two species this could be confounded with are *P. canifrons*, Smith, and *P. perplexus*, Smith, but the former has the "metathorax smooth, rounded behind," and the latter is a smaller, slighter insect, with much darker wings. From both species *P. Dædalus* differs in the colour of the antennæ, tibiæ, and tarsi.

POMPILUS INFESTUS, sp. nov.

♀. Head, thorax, and abdomen smooth; the clypeus convex, transversely rectangular, its sides rounded; the front of the face flat, with an abbreviated impressed line from the anterior ocellus to between the bases of the antennæ; median segment short, rounded posteriorly with a steep slope to its apex; legs stout, the tibiæ and tarsi with a few scattered spines, claws unidentate. Ferruginous red; the wings flavo-hyaline, broadly fuscescent at the apex, nervures brown, tegulæ ferruginous; the clypeus, the inner margin of the eyes, a line on the posterior border of the pronotum, a spot on the posterior tibiæ at base, the basal two joints of the intermediate and posterior tarsi, and the 3rd and 4th segments of the abdomen, rich chrome-yellow.

♀. Length 15 millim.; exp. 25 millim.

Hab. India.

The type and only specimen is in the collection of the British Museum. This is a very distinct species—a true *Pompilus* with the colouring of a *Ceropales*.

POMPILUS UNIFASCIATUS. (Pl. XIX. figs. 4, 4*a*.)

Pompilus unifasciatus, Smith, Cat. Hym. iii. p. 145. 133, ♀ ♂; id. Journ. Linn. Soc. xi. (1867), p. 352. 8.

Pompilus exortivus, Smith, Trans. Ent. Soc. 1873, p. 188. 7, ♀.

From a comparison of the descriptions and of a specimen in the Museum collection from Shanghai labelled *Pompilus exortivus*

in the late Mr. Smith's own handwriting, I have no doubt in my mind that *P. unifasciatus* and *P. exortivus* are one and the same species. The type specimen of the latter is somewhat larger and has the median segment more yellow and the legs with more black, but otherwise they are identical in sculpture and markings.

POMPILUS BIOCULATUS, sp. nov.

♀. Head, thorax, and abdomen smooth, pruinose; clypeus subconvex, its anterior margin arched, its posterior nearly transverse; scutellum large, laterally compressed; the median segment short, with a rounded truncation posteriorly; legs with the tibiæ and tarsi spinose, the spines short and stout, not disposed in rows, claws unidentate; abdomen sessile. Black; the head, except an irregular black mark on the front reaching the base of the antennæ, a broad stripe on the posterior margin of the pronotum, a square spot at the apex of the mesonotum, the scutellum in the middle, the legs except the coxæ, trochanters, base of the femora and the apical joints of the tarsi, and two lateral linear spots at the base of the 2nd segment of the abdomen, ferruginous yellow; wings ferruginous, with their apical margins broadly fuscous. The spots on the abdomen are sometimes obsolete, but can nearly always be detected by holding the insect up to a good light.

♂. Very similar, has more black mixed with the ferruginous yellow on the head and thorax, and is smaller and slighter.

♀. Length 12–17 millim.; exp. 30–35 millim.

♂. Length 10–11 millim.; exp. 25–32 millim.

Hab. Sikkim; Burma; Tenasserim; extending to China and Japan.

In Mr. Rothney's collection, worked out by Mr. Cameron, there is one specimen of this species labelled *Pompilus unifasciatus*, Smith, in the late Mr. Smith's own handwriting, and is entered under that name by Mr. Cameron in his paper (Hym. Orient., Mem. Manch. Lit. & Phil. Soc. 1891, p. 470), but with a note to the effect that it differs from the type of *P. unifasciatus*. I have a series of over a hundred of both species, and the difference between them is constant and well-marked.

POMPILUS ALICIÆ, sp. nov. (Pl. XIX. figs. 5, 5*a*.)

♀. Head, thorax, and abdomen smooth, very slightly pruinose; clypeus broader than high, convex, slightly projecting anteriorly, somewhat emarginate in the middle; prothorax squarish in front; posterior margin of the pronotum arched; median segment rounded,

with a very steep slope to the apex; legs stout, the tibiæ and tarsi spinose, the spines long and irregular; abdomen subsessile, as long as the head and thorax together, its apical segment studded with stiff hairs. Black; the basal two-thirds of the clypeus, the front and vertex, the scape of the antennæ, a broad band on the posterior margin of the pronotum, a square spot at the apex of the mesonotum, the centre of the scutellum and postscutellum, and the tibiæ and tarsi of the legs, ferruginous yellow; wings ferruginous, broadly infuscated at apex, the nervures and tegulæ ferruginous; abdomen black, an abbreviated yellow line at the base of the 2nd and 3rd segments above, the apical segment with pale yellow silky pile and long ferruginous hairs. The ferruginous yellow markings on the head, thorax, and legs are sharply defined off from the black.

♀. Length 20 millim.; exp. 36 millim.

Hab. Mergui, South Tenasserim.

Resembles the preceding species, but differs in the shape of the clypeus and the median segment and markedly in coloration.

Genus Salius, *Fabr.*

Hemepepsis *group.*

Salius Autolycus, sp. nov. (Pl. XIX. fig. 6, ♀.)

♀. Head and thorax opaque, pruinose; abdomen smooth and shining; clypeus transverse, its anterior margin widely emarginate in the middle, the sides oblique; the front subconcave, an impressed line from the anterior ocellus to between the bases of the antennæ; the flagellum of the antennæ thick, convolute; the vertex strongly arched; the pronotum short, rounded in front, its posterior margin arched, the mesonotum subconvex; the scutellum and postscutellum raised and laterally compressed; median segment long, rounded, transversely striated, its apex abruptly truncate, the truncation smooth and shining; legs long, robust, the tibiæ and tarsi strongly spinose; the intermediate and posterior tibiæ flattened and grooved above but not serrated, claws bidentate; abdomen sessile, the transverse furrow on the 2nd ventral segment shallow. Black; the mandibles except at the apex, the clypeus, and the antennæ castaneous brown; the head, pro- and mesonotum covered with a short thick velvety pile; the coxæ in front, the femora, tibiæ, and tarsi ferruginous, shading to fuscous black on the tarsi below; wings very dark brown, with a superb effulgence

of blue and purple; abdomen black, the apical three segments with large obscure lateral spots of orange-red above, and similar smaller spots on the ventral side.

♀. Length 60 millim.; exp. 106 millim.

Hab. Kilimanjaro.

A large handsome species allied to *Salius* (*Hemipepsis*) *prodigiosa*, Gerst., but much larger, and differing in the shape and sculpture of the thorax and in the colour of the abdomen.

Salius satelles, sp. nov. (Pl. XIX. fig. 7, ♂.)

♂. Pruinose; the clypeus small, convex, its anterior margin almost transverse in the middle and slightly bent downwards; the mesonotum broad, subconvex, slightly aciculate; scutellum and postscutellum raised in the middle, very prominent, the latter forming a tubercle; median segment long, somewhat truncate at apex, transversely striated, raised in the middle, on either side of which it is broadly longitudinally sulcate, the sides again being slightly raised and ending at the apex in well-marked but blunt projections; legs long and slender, the tibiæ and tarsi feebly spinose, claws bidentate; abdomen short, vertically compressed, the ventral furrow on the 2nd segment feebly indicated. Intensely black, the clypeus only being alutaceous, and the underside of the antennæ slightly fulvous; wings fuscous, with a broad hyaline yellow transverse band across the disc extending from the apical half of the basal cell in the fore wing to a little beyond the base of the 2nd cubital and 2nd discoidal cells; the nervures fuscous black, yellow on the hyaline portion of the wing; tegulæ black.

♂. Length 22 millim.; exp. 52 millim.

Hab. Ataran Valley, Tenasserim.

Allied to *Salius bellicosus*, Smith, *Salius anthracinus*, Smith, and *Salius hercules*, Cameron, compared with the same sex of which it differs in being slighter and smaller, with proportionately larger and broader wings, and in the shape and sculpturing of the median segment.

Salius aureosericeus.

Pompilus aureosericeus, Guér. Voy. Coq., Zool. pt. 2, p. 256.

? *Priocnemis gigas*, Taschenb. Zeits. ges. Naturwiss. xxxiv. (1869) p. 40.

Salius Elizabethæ, Bingh. Journ. Bomb. Nat. Hist. Soc. viii. p. 372, pl. 1. f. 9 (1894).

A very widely distributed and, so far as size and the colour of

the apical two segments of the abdomen go, very variable species. There is I think no doubt that the Burmese form (my *S. Elizabethæ*) is only a race of this species, and I have also united to it, though with some doubt, Taschenberg's *Priocnemis gigas*. Taschenberg's description clearly shows his species has the *Hemipepsis* or *Mygnimia* neuration, and, so far as I can make out, the sculpturing and colour agree very well with those of *P. aureosericeus*. This species is a good example of the uselessness of wing-neuration only as a generic character. I have examples of it, all with bidentate claws, that have the typical *Mygnimia*, and others that have the *Priocnemis* neuration.

♀. Length 32–41 millim.; exp. 66–84 millim.

♂. Length 27–31 millim.; exp. 60–70 millim.

SALIUS FENESTRATUS.

Mygnimia audax, Smith, Cat. Hym. iii. p. 182. 4, ♀; nec *Pompilus* (recte *Salius*) *audax*, Cat. iii. p. 136. 85.

Mygnimia fenestrata, Smith, Cat. iii. p. 184. 10, ♂.

Salius audax, Cam. Mem. Manch. Lit. & Phil. Soc. 1891, p. 442.

Salius funestus, Cam. Mem. Manch. Lit. & Phil. Soc. 1891, p. 444. 13.

Hab. Silhet; Kumaon; Sikkim; Tenasserim.

This handsome species is common in Sikkim and on the higher hills in Tenasserim. There seem to be two races—one (*audax*, Smith), with the wings deep ferruginous yellow; and a second (*fenestratus*, Smith, *funestus*, Cam.), which has the wings dark fuscous with a purple effulgence, though it is absolutely identical in the form and sculpture and markings of the body. In fact one specimen of the latter in the Museum collection is labelled "*Mygnimia audax*, var." in the late Mr. Smith's own handwriting.

Priocnemis *group*.

SALIUS VALENTULUS, sp. nov.

♀. Head, pronotum, sides of the mesonotum, scutellum and postscutellum smooth, very slightly pruinose; the mesonotum aciculate in the middle; median segment finely and closely transversely striate, posteriorly rounded with a gradual slope, the apex truncate, the truncation slightly concave; legs stout, the tibiæ and tarsi strongly spinose, the posterior tibiæ serrated, claws bidentate; abdomen short, with the basal segment petiolate, the 2nd ventral segment with a well-marked transverse furrow. Black; the wings

hyaline, broadly fuscescent at apex; the basal two segments of the abdomen and the basal half of the 3rd segment above ferruginous red; the remaining segments black, the apical segment with stiff fulvous hairs; beneath, only the 1st and basal half of the 2nd segment are red, the rest of the abdomen being black studded with scanty fulvous hairs.

♀. Length 16 millim; exp. 26 millim.

Hab. North-West Provinces, India.

Resembles *Salius Juno*, Cameron, with the type of which in Mr. Rothney's collection I have compared it; but, apart from the great difference in size and in the colour of the abdomen, the clypeus in this species has the anterior margin transverse, almost truncate in the middle; in *S. Juno* it is rounded: the median segment in *S. Juno* is long and gradually rounded to the apex, in *S. valentulus* it is short with the apex truncate.

SALIUS TERRENUS, sp. nov. (Pl. XIX. fig. 8, ♀.)

♀. Head and thorax pruinose, median segment finely transversely striated, abdomen finely aciculate; clypeus large, its anterior margin boldly arched and fringed with long hairs, the posterior transverse; scutellum and postscutellum laterally compressed and very prominent, the former longitudinally and the latter obliquely striated on the sides; median segment with a very steep slope to the apex, scarcely rounded above, somewhat compressed at the sides; legs long, the tibiæ and tarsi strongly spinose, the posterior tibiæ serrated; abdomen petiolate, the 2nd ventral segment with a well-marked transverse furrow. Dull red; the clypeus, the face in front, and the pro- and mesonotum with dense golden pile, very brilliant and glittering in certain lights; median segment shaded with fuscous black; abdomen with the base of the 1st and apex of the 1st, 2nd, and 3rd segments broadly black, the black not continued as bands on the underside; the wings a pale oily brown, hyaline, and in certain lights iridescent; a faint fuscous cloud occupies the 2nd and 3rd cubital and upper part of the 2nd discoidal cells.

♂ similar, but the wings have a larger faint fuscous cloud at apex beyond the 2nd cubital cell.

♀. Length 20 millim.; exp. 44 millim.

♂. Length 18 millim.; exp. 38 millim.

Hab. Sikkim; Burma; Tenasserim.

Resembles *Salius Nicevillii*, mihi, from which it differs in being much smaller, duller in colour, and in the median segment

being produced but slightly posteriorly, only sloping steeply from base to apex.

SALIUS GRASSATOR, sp. nov.

♂. Pruinose; the clypeus small, convex, its anterior margin sharply transverse, the sides oblique, above it is subangular, the base being truncate; eyes very convergent above, ocelli remarkably large and prominent; the antennæ straight and filiform; prothorax short, rounded in front, the posterior margin subarcuate; scutellum and postscutellum prominent; median segment long, with a very gradual slope to its apex, finely transversely striated and bearing a medial longitudinal furrow from base to apex; legs long, the tibiæ and tarsi spinose, the posterior tibiæ with the serrations just indicated; claws strongly unidentate below; abdomen petiolate, slightly aciculate, the 2nd ventral segment with a well-marked transverse furrow. Head, thorax in front, and the femora, tibiæ, and tarsi of the legs ferruginous red; the sides of the thorax, pectus, median segment, coxæ and trochanters dull blackish; the whole thorax covered with a fine sericeous golden pile, dense on the face in front, pro- and mesonotum, and thin and scanty on the sides of the thorax and median segment; abdomen dark castaneous red, lighter in the middle of the basal segment, and covered with a short fine ferruginous pile seen only in certain lights; wings pale flavo-hyaline, the apex of the fore wing from beyond the middle of the 2nd cubital cell to the apex of the 3rd dark fuscous, beyond that to the apex of the wing lightly fuscescent.

♂. Length 17 millim.; exp. 36 millim.

Hab. Sikkim, at low elevations. A very distinct species.

SALIUS GEMINUS, sp. nov.

♀. Closely resembles the European *Salius serripes*, Dahlbom, and is in fact the Himalayan representative of that species. Head, thorax in front, and abdomen smooth; median segment lightly transversely striate; clypeus transversely oval, its anterior margin thickly fringed with long hairs; front slightly convex, an impressed vertical line from the anterior ocellus to between the base of the antennæ; median segment long, as long as the rest of the thorax, rounded with a gradual slope to its apex; antennæ and legs long, the tibiæ and tarsi of the latter strongly spinose, the posterior tibiæ markedly serrate; abdomen fusiform, petiolate, as long as the head and thorax together, the 2nd ventral segment

with a deep transverse furrow. Dull opaque black, the basal two segments above and below and basal half of the 3rd segment of the abdomen above red; there are also indications of the red colour on the apical margins above of the 3rd and 4th segments; the thin scattered pubescence on the head and thorax is black, and on the apical segments of the abdomen ferruginous; wings hyaline, the apex of the fore wing broadly fuscescent.

♀. Length 13 millim.; exp. 22 millim.

Hab. Mussoorie, N.W. Himalayas.

SALIUS VENATORIUS, sp. nov. (Pl. XIX. fig. 9, ♀.)

♂. Head, thorax in front, and abdomen smooth, very slightly pruinose, median segment lightly transversely rugose; clypeus large, its anterior margin arcuate and slightly reversed, posterior bisinuate; front of the face slightly concave, an impressed vertical line from the anterior ocellus to between the antennæ; vertex of the head compressed, narrow; antennæ thick, setaceous; pronotum very short, anteriorly and posteriorly arched; post-scutellum compressed, tuberculate; median segment long, with a very gradual slope to the apex, a deep short fovea at its base; legs long, the tibiæ and tarsi slightly spinose, claws unidentate; abdomen vertically compressed, the furrow on the 2nd ventral segment barely indicated. The head, pronotum, apex of the femora, tibiæ and tarsi light ferruginous, a dusky stain on the front from the vertex to the base of the antennæ, the antennæ at apex fuscous; the thorax except the front of the prothorax, coxæ, trochanters, basal half of the femora, and abdomen alutaceous brown, the last with a rich purple bloom in certain lights; wings fuscous brown, flavo-hyaline on the disc from the apical half of the 1st cubital and 1st discoidal cells to the 3rd cubital and 3rd discoidal cells; a dark spot with a hyaline border posteriorly at the base of the 1st discoidal cell.

♂. Length 13–18 millim.; exp. 24–28 millim.

Hab. Hills of Burma and Tenasserim.

Resembles *S. satelles*, but is structurally and in coloration abundantly different.

SALIUS PLACIDUS, sp. nov.

♂. Head and thorax densely pruinose; abdomen smooth and shining; clypeus short, vertical, nearly flat, its anterior margin transverse in the middle, oblique at the sides; antennæ

very long and thick, the scape laterally compressed, somewhat flattened, front concave, frontal furrow well-marked; ocelli large and prominent; pronotum very short, rather square anteriorly, arched behind; scutellum and postscutellum laterally compressed; median segment long, rounded posteriorly, with a very gradual slope to its apex, smooth, with only a few transverse striæ; legs long, the tibiæ and tarsi only slightly spinose; claws unidentate; abdomen vertically compressed, the transverse furrow on the 2nd ventral segment barely indicated. Head and thorax black; the femora, tibiæ, and tarsi of the legs light ferruginous; abdomen ferruginous red; the mandibles except at their apex, the clypeus except a spot in the middle, the face below the antennæ, and the inner margin of the eyes, not reaching the vertex, pale yellow; the antennæ beneath and the anterior coxæ in front fulvous, the base of the abdomen fuscous. The head and thorax are covered with a glistening silvery silky pile, and in certain lights the apical margins of segments 1–4 of the abdomen above are seen to be broadly darker in colour. Wings subhyaline purplish brown, with clear hyaline spaces in the 1st discoidal and 2nd submedial cells of the fore wing, and in the anal and discoidal cells of the hind wing.

♂. Length 15 millim.; exp. 34 millim.

Hab. Tenasserim.

A very distinct little species.

Genus MACROMERIS, *Lepel.*

MACROMERIS CASTANEA, sp. nov.

♀. Head and thorax in front pruinose, median segment coarsely rugose; legs and the abdomen smooth and shining; clypeus large, subconvex, covered with long pubescence, its anterior margin arched with a waved outline, the middle produced into an acute tooth with a blunt rounded projection on each side; mesonotum convex; scutellum and postscutellum raised, prominent, the latter tuberculate in the middle; median segment rounded, steeply sloped posteriorly, coarsely cribrate; the mesonotum at apex, the sides of the scutellum and postscutellum, and the thorax beneath the wings obliquely striated, the latter below, in front of the intermediate coxæ, produced into prominent lateral tubercles; the wings have the radial cell in the fore wing large and rounded at apex, the 1st recurrent nervure is received in the apical third of the 2nd cubital cell, and the 2nd recurrent

nervure in the middle of the 3rd cubital cell; legs long, smooth, and entirely without spines, claws bidentate; abdomen petiolate, the 2nd ventral segment with a well-marked transverse furrow. Colour dark chestnut-red; the vertex, sides of the thorax, and abbreviated apical bands on segments 1–4 of the abdomen fuscous black, these bands produced forward angularly in the middle; wings hyaline with a yellowish tint, nervures and tegulæ testaceous brown. The short, fine, scanty pubescence on the head and thorax anteriorly chestnut-brown.

♀. Length 24 millim.; exp. 50 millim.

Hab. Java.

A very distinct and well-marked form, differing from the only two other described species of the genus in the shape of the thorax and notably in the colour of the body and wings. The type and only specimen is evidently an insect collected many years ago, though still in fair preservation.

Genus Dolichurus, *Latr.*

Dolichurus bipunctatus, sp. nov.

♂. Head in front and the median segment rugose; the vertex, back of the head, pro- and mesonotum, and abdomen smooth; head and thorax with a thin short pubescence, dense only on the clypeus; pronotum transverse, the tubercles at the anterior angles well-marked and prominent; mesonotum with two medial, longitudinal, somewhat deep furrows; median segment flat above, the sides steeply sloped, the apex truncate, a transverse carina at the base, two medial longitudinal carinæ from the base to the margin of the truncation, with a transverse carina there joining them, two other outer carinæ parallel to them, with a second transverse carina below the margin of the truncation joining them, the surface between the carinæ is roughly transversely striate; legs stout, without spines, the femora flattened; abdomen short, the posterior margins of the basal two segments strongly constricted, the 1st above and below, the 2nd only above. Black, the pubescence fulvous white; the concave projecting plate above the antennæ, on the outer margin, and the tubercles at the outer angles of the pronotum yellow; wings hyaline and iridescent, nervures and tegulæ testaceous.

♂. Length 9 millim.; exp. 16 millim.

Hab. Pegu Hills, Burma.

Nearly allied to *D. taprobanæ*, Smith, but that species has the

front of the head smooth, not punctured, the thorax for the most part and the abdomen polished and shining, and the superantennal plate on the outer margin with the tubercles on the pronotum black not yellow.

Genus PHILANTHUS, *Fabr.*

Div. 1. *Abdomen sessile.*

PHILANTHUS AVIDUS, sp. nov.

♀. Head very closely and finely, thorax and posterior margin of the basal segment of the abdomen more distantly and coarsely punctured, the base of the 1st, the 2nd and following segments of the abdomen smooth; head broad, as broad as the thorax; mesonotum strongly convex; median segment short, subcylindrical above, level and with the apex steeply sloped, almost truncate, a central longitudinal broad but shallow furrow runs from base to apex, the sides and apex with a thin scanty pubescence; legs with the tibiæ and tarsi spinose; abdomen with the basal segment slightly constricted along the extreme apex of the posterior margin above, the apical segments of the abdomen slightly pubescent. Black; the mandibles except at apex, the clypeus, a moon-shaped spot above it, a spot on each side of the face above the base of the antennæ, the scape in front, the inner margin of the eyes, a line behind them, a line on the front of the pronotum, the tegulæ, the postscutellum, the tibiæ and tarsi of the legs above, two lateral subapical spots on the basal segment, and narrow subapical bands, continued on the ventral side, on segments 2–5 of the abdomen pale yellowish white; the basal segment, except for a narrow subapical border above, deep red; wings hyaline, faintly fuscous and in certain lights iridescent.

♀. Length 10 millim.; exp. 16 millim.

Hab. Tenasserim.

Closest to *P. pulcherrimus*, Smith: differs in the thorax being more closely punctured, and in the abdomen being smooth without punctures: in colour it differs considerably; the scutellum is black not yellow, the coxæ and femora are black not rufo-piceous, and the apical segment is black not yellowish white. It is also a considerably larger and stouter insect than *P. pulcherrimus*. From *P. basalis*, Smith, it differs in being much slighter, and in the colour of the legs and the markings on the head and face.

PHILANTHUS ORDINARIUS, sp. nov.

♀. Head and thorax closely and finely punctured; abdomen smooth, opaque; head slightly broader than the thorax, flattened in front; mesonotum convex, smooth and shining in the middle; scutellum large, prominent, without punctures in the middle; median segment rounded posteriorly, with a narrow central longitudinal furrow from base to apex, the apex and sides pubescent; legs with the tibiæ and tarsi, especially of the posterior pair, strongly spinose; abdomen broad and about as long as the head and thorax together. Black; the mandibles except at apex, the clypeus, a semicircular spot above it, the inner orbits as high as the emargination of the eyes, a line along the outer orbits not reaching the vertex, a line on the pronotum, the tegulæ, a line on the posterior margin of the postscutellum, two small lateral spots on the median segment, the femora, tibiæ and tarsi of the anterior legs, the apex of the femora, the tibiæ, and tarsi of the four posterior legs above, and an irregular waved subapical line above and below on segments 2–4 of the abdomen, pale yellowish white; the base of the 1st segment broadly and of the 2nd narrowly red; wings hyaline, nervures sordid yellow.

♀. Length 12 millim.; exp. 22 millim.

Hab. Tenasserim.

Resembles the preceding species, but differs in the shape of the median segment and scutellum, and considerably in the markings. It is smaller than the type of *P. basalis*, Smith, in the Museum, and differs also from it in the markings and in the sculpture of the thorax.

PHILANTHUS NIGRICEPS, sp. nov.

♂. Head finely and closely punctured, thorax smooth and shining, the mesonotum, scutellum, and postscutellum with a few distant punctures; the median segment smooth and impunctate at base and down a central line to the apex, the apex on either side closely punctured and pubescent; the legs punctured and covered with a thin fine pubescence; abdomen shining, with the bases of segments 2–5 broadly depressed, the depressions forming marked bands very finely transversely striate; the basal segment, the apical margins of the 2nd to 5th, and the apical two segments finely and distantly punctured, the last slightly pubescent at the sides and below. A remarkable feature is the clypeus, which is porrect and broadly emarginate in the middle anteriorly. The

head and thorax black, abdomen dark chestnut-red; the mandibles except at their apex, the clypeus, two spots above it, the inner margin of the eyes broadly but diminishing in width upwards, two large spots behind the eyes, a line on the pronotum, a spot before the tegulæ, a line on the postscutellum anteriorly, and large triangular lateral subapical spots on segments 1–4 of the abdomen, with an irregular line interrupted in the middle on the 5th segment above, yellow; legs rufo-piceous, the anterior femora, tibiæ, and tarsi, and the apex of the femora, the tibiæ and tarsi of the intermediate legs with a deep fulvous tinge; wings fusco-hyaline and iridescent, the nervures and tegulæ testaceous. Pubescence fulvous.

♂. Length 13 millim.; exp. 24 millim.

Hab. India.

A large and very distinct species, unlike any other known to me.

Div. 2. *Abdomen petiolate.*

PHILANTHUS CONCINNUS, sp. nov.

♀. Head and thorax finely and closely punctured, abdomen smooth but not shining; head broad, broader than the thorax, obscurely subpubescent; mesonotum broad convex; scutellum prominent, divided longitudinally by a broad shallow furrow; median segment rounded and steeply sloped posteriorly; legs stout, the tibiæ and tarsi of the intermediate and posterior legs thickly spinose, the anterior tarsi ciliated on the outside; abdomen long, as long as the head and thorax together, the petiole constricted at apex. Black; the base of the mandibles, the clypeus, a crescentic mark above it, the inner margin of the eyes as high as the insertion of the antennæ, a spot on the scape in front, a narrow line sloping obliquely back behind the eyes, an abbreviated line on the pronotum broadly interrupted in the middle, a spot on the tegulæ in front, two minute, obliquely placed spots in the centre of the postscutellum, and an irregular waved subapical line, continued on the ventral side, on the posterior margins of segments 2–4 of the abdomen, with a transverse spot on the apical margin of the 5th, yellow. The line on the 2nd segment is narrowly interrupted in the middle, and there is a large lateral red spot coalescing in the middle at the base of the same segment. Legs variegated with yellow; wings lightly fusco-hyaline and iridescent, nervures and tegulæ testaceous. The

fine sparse pubescence on the head and sides of the median segment is white. A variety has the yellow markings on the postscutellum, the legs, and abdomen obsolete, or nearly obsolete, reduced on the last, in some specimens, to an oval spot on either side of the 2nd segment, and only indications of a yellow line on the 4th and 5th segments.

♀. Length 12 millim.; exp. 22 millim.

Hab. Tenasserim.

Genus Psen, *Latr.*

Psen pulcherrimus, sp. nov.

♀. Head above, thorax, and abdomen smooth and shining, the clypeus densely pilose; clypeus small, convex, the front between the eyes broad; the flagellum of the antennæ testaceous, the 2nd joint as long as or longer than the 3rd and 4th together; ocelli in a triangle wide apart from each other, each ocellus in a pit; the apex of the mesonotum and the sides and apex of the postscutellum with coarse outwardly oblique striæ; median segment long, rounded posteriorly, with a well-marked longitudinal furrow in the middle from base to apex; legs stout, the posterior tibiæ with very minute spines; abdomen with the apices of segments 2–4 slightly constricted. Head and thorax black, abdomen ferruginous red; the scape and the basal five joints of the flagellum of the antennæ below, a line on the pronotum, a spot before the tegulæ, the tegulæ, a large square spot at the apex of the mesonotum, the scutellum and postscutellum, two large oblong spots at the apex of the median segment, the apex of the coxæ, the trochanters, femora, tibiæ, and tarsi of the legs, and the petiole of the abdomen, yellow; the femora, tibiæ, and tarsi of the posterior legs have a fuscous stain, and the apex of the petiole below is black; wings hyaline and beautifully iridescent, the nervures testaceous.

♀. Length 7 millim.; exp. 12 millim.

Hab. Amherst (Tenasserim).

Genus Crabro, *Fabr.*

Div. 1. *Abdomen sessile.*

Crabro alacer, sp. nov.

♀. Head, thorax, and abdomen punctured, the punctures on the head and especially on the abdomen very fine and close, on

the thorax they are fine anteriorly, gradually becoming coarser towards the back, till on the apex of the mesonotum, scutellum, and postscutellum they run into longitudinal striæ, and on the median segment form a coarsely rugose cribrate surface; clypeus and base of the mandibles densely pubescent with silvery pile; a short vertical furrow between the bases of the antennæ, and a central longitudinal carina from the middle of the mesonotum to the anterior margin; the tibiæ of the legs broad, coarsely rugose on the outside; abdomen with the bases of the segments slightly constricted. Intense black, the scape of the antennæ in front yellow; the posterior margin of the pronotum, an oblong large spot in the middle of the scutellum, the posterior margins narrowly of segments 1–4 of the abdomen, a broad band in the middle of the 2nd segment, and a spot on either side in the middle of the 3rd segment, brick-red; the apical two segments fringed posteriorly with thin golden pubescence; wings fusco-hyaline, slightly iridescent, nervures and tegulæ testaceous.

♀. Length 12 millim.; exp. 22 millim.

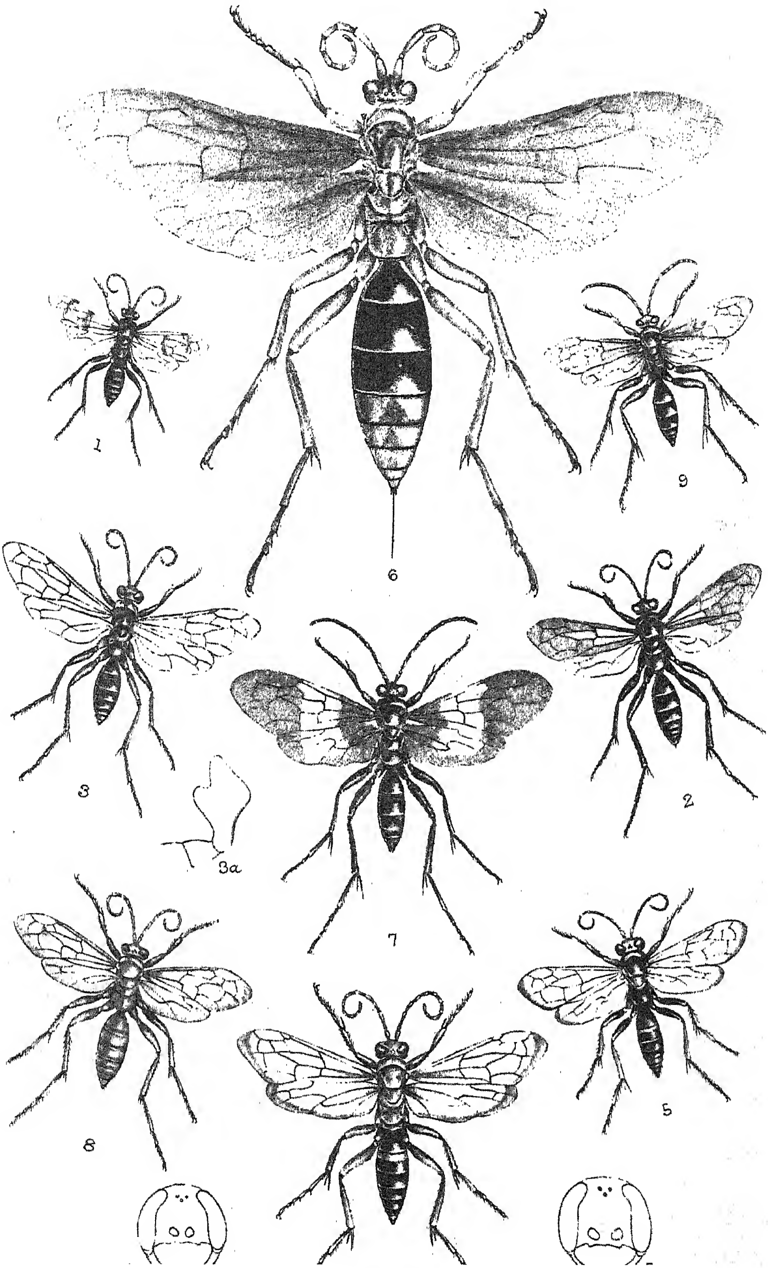
Hab. Sumatra.

Allied to *C. tridentatus*, Smith, from Australia, but smaller, and differing considerably in the puncturing and sculpture of the head and thorax. In *tridentatus* the head and thorax anteriorly are smooth but not shining, and the median segment is only longitudinally striate at base, not roughly cribrate.

Div. 2. *Abdomen petiolate.*

CRABRO (RHOPALUM) BROOKII, sp. nov.

♀. Head, thorax, and abdomen opaque, very closely and finely punctured; the clypeus, front above the antennæ, the cheeks behind the eyes, and the sides of the thorax with thick silvery pubescence; the extreme apical margin of the mesonotum with short longitudinal, and the postscutellum and base of the median segment with oblique divergent striæ, the last subtruncate, with an enclosed triangular space at the base, a central longitudinal furrow, and an oblique outwardly diverging furrow on the posterior angles; legs with the intermediate and posterior tibiæ broad and somewhat spinose; abdomen, the petiole constricted at apex; the apex of the abdomen acute. Black; the scape of the antennæ, a line on the pronotum, a large and a small spot at the outer angles of the scutellum, with the tibiæ and basal joints of the tarsi of all the legs on the outer side yellow, apical joints


1
6
9
3
3a
7
2
8
5

of the tarsi ferruginous; abdomen with the apical segment above obscurely, and an irregular oblique streak on each side of the 3rd segment at base a beautiful pale green, the apical two segments are also fringed with a thin white pubescence; wings hyaline and iridescent, nervures and tegulæ testaceous.

♀. Length 12 millim.; exp. 20 millim.

Hab. Kumaon, N. India.

A very beautiful and distinct species, which I have ventured to name after its collector.

EXPLANATION OF PLATE XIX.

Fig. 1. *Pseudagenia Erigone*, sp. nov., ♀.
2. „ *artemis*, sp. nov., ♀.
3. *Paragenia argentifrons*, Smith, ♀.
3 *a*. „ „ „ ♂. Outline of intermediate coxa.
4. *Pompilus unifasciatus*, Smith, ♀.
4 *a*. „ „ „ ♀. Head from the front.
5. „ *Aliciæ*, sp. nov., ♀.
5 *a*. „ „ „ ♀. Head from the front.
6. *Salius Autolycus*, sp. nov., ♀.
7. „ *satelles*, sp. nov., ♂.
8. „ *terrenus*, sp. nov., ♀.
9. „ *venatorius*, sp. nov., ♂.

On the Tooth-genesis in the *Canidæ*. By H. W. MARETT TIMS, M.D., F.Z.S., Lecturer on Biology and Comparative Anatomy, Westminster Hospital Medical School. (From the Huxley Research Laboratory, Royal College of Science, London.) (Communicated by Prof. G. B. HOWES, Sec. Linn. Soc.)

[Read 7th May, 1896.]

THE main object with which this research was undertaken was to trace the order of cusp-development and the inter-relationships of the various cusps in the teeth of the Canidæ, and to examine into the evidence thereby obtained bearing upon important and interesting problems of Phylogeny.

While this has been the main object, other secondary questions have not been overlooked. These questions may be briefly enumerated as follows:—

(i.) Whether of the upper cheek-teeth, $\underline{\text{pm.}^4}$ or $\underline{\text{m.}^1}$ more nearly approximates to the type tooth, and is therefore safest for the comparison of known forms?

(ii.) Is there a diverse modification of the teeth for opposite ends of the jaw?

(iii.) Is the *Milk* or the *Permanent* dentition the more primitive?

(iv.) Is *Otocyon* primitive in the number and characters of its teeth?

To these questions I have endeavoured to give an answer.

The general character of the teeth of the Common Dog are known to all, and a brief description of these characters is to be found in most text-books of Comparative Anatomy; but, so far as I am aware, no detailed description of the individual teeth in this and other members of the same family has as yet been given.

In 1880 the late Professor Huxley published (7) his well-known monograph "On the Cranial and Dental Characters of the Canidæ." In this paper a classification of the Dogs was proposed, based largely upon certain dental characters, especially size in relation to the basi-cranial axis. He did not touch upon the characters of the individual teeth which bear upon the homologies and inter-relationships of the cusps.

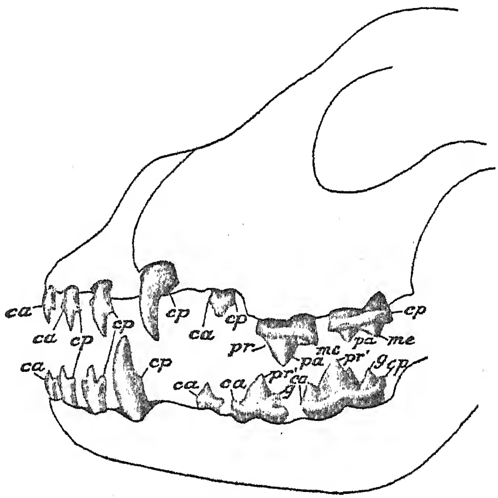
I propose therefore, in the first instance, to give a detailed description of the Milk and Permanent teeth of the Dog. In doing so, I shall employ Osborn's terms, but I shall do so merely as a matter of convenience and not as implying that I thereby accept the Tritubercular theory which he upholds.

Method.—The jaws of animals varying in age from about the seventh week of intra-uterine life up to three months were examined. After being thoroughly dehydrated and clarified in oil of cloves, one side of the jaw was dissected off and the teeth examined *in situ*. The younger specimens were also examined microscopically. The jaws were decalcified in a 1-per-cent. solution of chromic and hydrochloric acids. After staining in borax-carmine, serial sections were cut and models made in wax of some of the developing teeth.

Description of the Milk-teeth.—The dental formula of the deciduous teeth is i. $\frac{3-3}{3-3}$, c. $\frac{1-1}{1-1}$, m. $\frac{3-3}{3-3}=28$. The order and

dates of eruption are as follows :—The first tooth to cut the gum is the lower carnassial ($\overline{\text{dpm.}^4}$), and this is quickly succeeded by the upper ($\underline{\text{dpm.}^3}$). The former just makes its appearance about the end of the second week. By the end of the third week these teeth are well through and $\overline{\text{dpm.}^3}$ and $\overline{\text{c.}}$ are commencing to appear, the former slightly preceding the latter. These are soon followed by $\underline{\text{c.}}$ and $\underline{\text{i.}^3}$, which cut the gum at nearly the same time. $\underline{\text{dpm.}^2}$ appears next, and about the same time $\underline{\text{dpm.}^4}$. These are followed by the remaining upper incisors, and then by the lower incisors. The last deciduous tooth to be erupted is $\overline{\text{dpm.}^2}$, which does not appear until nearly the third month.

Fig. 1.



Deciduous dentition of *Canis familiaris*, seen from the left side. Lettering explained in the text.

Upper Teeth.—The three upper incisors increase somewhat in size from within outwards, but they are all of the same pattern. When viewed anteriorly their crowns may be likened to a "fleur-de-lis," consisting of a main central cone with a small, but well-marked cusp on each of its sides (fig. 1, *ca* and *cp*). On the internal face there is a well-marked cingulum, which is seen to be continuous with these smaller cusps. On comparing the outer with the central incisors, it will be seen that the anterior (inner) cusp has a decided tendency to reduction or non-

development in the former, while the outer (posterior) cusp becomes decidedly more pronounced.

The canines are long, pointed, and recurved; the cingulum is scarcely, if at all, perceptible; the posterior cusp is usually to be recognized, and occasionally, but more rarely, the anterior one also. The cusps may be seen in fig. 1; the anterior cusps are marked *ca* and the posterior *cp*.

The first functional deciduous premolar ($\underline{\mathrm{dpm.}^{2}}$) is a conical tooth with two fangs. The cingulum is to be made out and in connection with it anterior and posterior cusps; the latter is the more pronounced and lies in the same antero-posterior line as the main cone, while the anterior cusp is placed slightly to the inner side of that line and is quite small.

The second functional deciduous tooth or milk carnassial ($\underline{\mathrm{dpm.}^{3}}$) is a much larger tooth and considerably more extended in the antero-posterior direction, as will be seen on reference to fig. 1. It bears two external cusps: the anterior, or Paracone (*pa*), considerably the larger, is conical, and its anterior slope is much greater than its posterior. The posterior, or Metacone (*me*), has a horizontal cutting-edge. The cingulum is well-marked along the inner side of the postero-external cusp and at the antero-internal side of the main cone, and in this latter situation is a well-marked cusp, the Protocone (*pr*). This tooth has three fangs—two in the antero-posterior line, as in the tooth in front, and a third sloping inwards and forwards like a buttress. The latter is united to the tooth on the inner face of the main cone, and it is here that the cingulum is deficient.

The third functional deciduous premolar ($\underline{\mathrm{dpm}^{4}}$) bears two external subequal cusps, the Paracone and Metacone (*pa* and *me*). The cingulum appears to surround these on the anterior, external, and posterior faces, while internally it is well-marked but carried inwards some distance, having a well-marked depression between it and the Paracone and Metacone. This is seen in fig. 3. At its most internal part the cingulum is raised up into a pronounced ridge-like cusp, the Protocone (*ci*).

Lower Milk-teeth.—The description already given of the upper incisors and canine will apply equally well to the corresponding teeth of the lower jaw.

The first functional deciduous premolar ($\overline{\mathrm{dpm.}_{2}}$) has a prominent conical cusp, the anterior border of which is almost perpendicular. The posterior border has a more decided slope, in the middle of

which is an indication of a cusp. On the inner side is a distinct cingulum, giving rise to well-marked anterior and posterior cusps (*ca* and *cp*), the former lying slightly to the inner side of the main cone, as is the case in the corresponding tooth of the upper jaw.

The *second functional deciduous premolar* ($\overline{\text{dpm.}^3}$) has exactly the same characters, but more pronounced, especially in the case of the cusp (*g*) on the posterior slope of the main cone, which is here of considerable size.

The *third functional deciduous premolar*, or lower carnassial ($\overline{\text{dpm.}^4}$), is a large and massive tooth and of considerable antero-posterior extent. It has a prominent cone about the middle of the external face, the Protoconid (fig. 1, *pr'*), in front of which is the Paraconid (*ca*), the free end of which forms a cutting-edge. Posteriorly is a cusp (*g*) entering into the formation of the so-called *heel*, and separated from the Protoconid by a large depression. The cingulum is marked on the posterior half of the internal face of this tooth; it gives rise to a minute cusp at the postero-external border of the tooth. On the ridge of the cingulum are two well-marked cusps—an anterior Metaconid, the larger, lying at the postero-internal angle of the Protoconid; and posteriorly a smaller cusp.

It will be noticed that I have refrained from applying names to any but the three primary cusps. I have done so, as I am unable to reconcile the cusps of some of the teeth, notably the lower carnassial, with the descriptions usually given. Even the Paraconid (the cusp usually described as the antero-internal), if examined in the lower carnassial, is antero-external, rather than antero-internal.

But, omitting these minor difficulties, is it possible to homologize the all-important Protocone?

I have been unable to find that any attempt has been made by the upholders of the Trituberculur theory to homologize the cusps of the premolar teeth with those of the molars. Scott (23) believes that in the upper *premolars* the protocone forms the antero-external cusp, a conclusion with which, as will be seen below, I entirely agree, and which appears to have been tacitly accepted by Osborn (16 & 17). But these writers do not appear to adopt the view that the main cone of the premolars is homologous with the paracone of the true molars. On p. 443 of his paper cited, Scott states that, "assuming the correctness of

Osborn's results as to the homologies of the molar cusps, those of the premolars are differently arranged."

In consideration of these facts, I would submit the following attempt at identification :—

To start from the upper carnassial tooth, in which there are two external cusps and a very minute antero-internal cingulum-cusp. Following Cope (2), the Paracone and Metacone are defined as the antero- and postero-external cusps, and I think it is justifiable to name the two main cones (fig. 1, *pa* and *me*) of this tooth the Paracone and Metacone. The other very minute cusp must then be the Protocone or antero-internal cusp. It is remarkable that the cone representing *the* primitive reptilian cone should be so diminutive, even allowing with Prof. Osborn (**13**) that the Paracone and Metacone have undergone "accelerated development."

Turning now to my own identifications in the $\frac{\text{dpm.}^2}{}$. There is a main cone with its internal cingulum, the latter structure giving rise to a small antero-internal cusp and a somewhat more pronounced posterior cusp lying in the same antero-posterior line as the main cone. I presume that the main or antero-external cone would be regarded by Professors Cope and Osborn as the Paracone, the postero-external cusp, which, as we have seen, is formed by the cingulum, as the Metacone, and the antero-internal cingulum-cusp as the Protocone. If this be so, and I see no other alternative, the Protocone is still more reduced, indeed scarcely perceptible.

In dealing with the canines and incisors there are two alternatives :—

(i.) That there is no internal cusp, and that therefore there can be no Protocone present; or

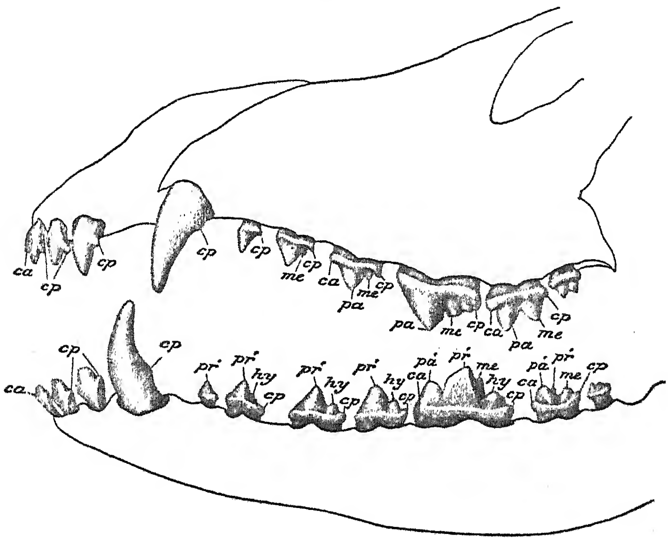
(ii.) That the cusp homologous with the so-called Protocone of the deciduous premolars is the small anterior cingulum-cusp (fig. 1, *ca*).

The latter alternative I believe to be the more probable. If this be so, I think it is trespassing too much upon credulity to regard this minute cingulum-cusp, and not the main central cone, as the primitive cone from which all the others have been derived. Moreover, this cusp is formed by the cingulum, which is itself regarded as a mammalian structure superadded to the reptilian type of tooth; and consequently it is a "reductio ad

absurdum" to derive the remainder of the tooth from this, a structure of admittedly later appearance than the tooth itself.

From this it will be seen that I regard the Protocone of the upper carnassial and the anterior cingulum-cusps of the anterior premolar, the canine, and the incisors as homologous.

Fig. 2.



Permanent dentition of *Canis familiaris.* Lettering explained in text.

Description of the Permanent Teeth of the Dog. (Fig. 2.)

The cusp *hy* is homologous with the cusp inadvertently lettered *g* in fig. 1.

Upper Jaw.—The central incisor has a well-marked central cone and decided lateral cusps, continuous with and formed by the cingulum.

The outer cusp is more distinct than the inner.

i.[2] possesses the same characters, but is somewhat larger.

i.[3] is more caniniform. The anterior (inner) cusp (*ca*) is scarcely noticeable, while the posterior is marked and situated nearer to the base of the tooth (*cp*).

All these teeth have well-marked internal cingula continuous with these small cusps.

The *canine* is a long, somewhat compressed, recurved tooth; the lateral cusps are not so distinct as in the deciduous canine, though the posterior cusp (*cp*) is still to be made out.

The *first premolar* (pm.[1]) is small and conical, its posterior slope being greater than the anterior. There is a posterior prominence (*cp*), hardly to be called a cusp, into which the well-marked internal cingulum runs. The cingulum

gives rise also to a slight indication of an antero-internal cusp. This tooth has but one fang.

The *second premolar* (pm.²) has two fangs. It is larger than pm.¹ but with the same characters more pronounced. In addition there is a minute cusp (*me*) between the main cone and the posterior cingulum-cusp (*cp*).

The *third premolar* (pm.³) has all these characters, but is larger and more pronounced. It is 2-fanged.

The *carnassial* (pm.⁴) again has the same characters, but the Protocone is proportionately more marked and supported on a separate fang, although very diminutive compared with the other cones.

The *first molar* (m.¹) has well-marked Para- and Metacones (*pa* and *me*), the former being slightly the larger. The cingulum is traceable on the external face and becomes prominent at the antero-external angle of the Paracone, in front of which it is continued. At the antero-internal angle at the base of this cone the cingulum divides, both portions being continued backwards separately to the postero-internal angle at the base of the Metacone. On the outer of these two cingulum-ridges rises the well-marked Protocone, between the base of which and the Paracone is a smaller cusp (fig. 3, *d*). At the posterior part of the outer cingulum, immediately behind the Protocone, is another cusp (fig. 3, *i*); the inner cingulum has two cusps placed upon it, as shown in fig. 3, A.

The *second molar* (m.²) has the same characters, but all is much smaller.

Lower Jaw.—The description given above of the upper incisors will apply equally to the corresponding teeth of the lower jaw, with the slight difference that the anterior (inner) cusp is less pronounced in the latter.

Canine. Same as in upper jaw.

Premolars. With the exception of the fact that the cusp (*hy*) situated between the main cone and the posterior cingulum-cusp is better marked, the characters of these teeth are the same as of the corresponding teeth in the upper series.

The *first molar*, or *lower carnassial* (m¹.), bears a high main central cone, the Protoconid (fig. 2, *pr′*), with an exceedingly well-marked Paraconid (*pa′*) anteriorly and slightly internal to the Protoconid. Posteriorly to the main cone is the so-called Hypoconid (*hy*), and at the posterior end of this the cingulum forms a small cusp (*cp*). On the inner side of the Hypoconid the cingulum is prominent and terminates anteriorly in the Metaconid (*me*) at the postero-internal angle of the Protoconid. At the postero-internal angle of the cingulum is another marked cusp, the Entoconid, between the base of which and the Metaconid is another small cusp.

The *second molar* (m.²) presents the same characters, with the exception of the absence of the Paraconid and that the Protoconid is scarcely higher than the other cusps.

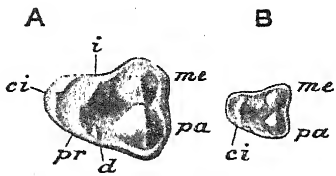
From a consideration of these teeth, the same difficulty in homologizing the Protocone is to be met with as has been pointed out in the deciduous teeth.

On external comparison of the two dentitions certain points are to be noted. In the first place, there is the well-known fact

that the upper permanent carnassial is preceded by a deciduous tooth molariform in character, and that the penultimate deciduous premolar has the *general* characters of the permanent carnassial. The same holds in the lower jaw in relation to $\overline{\mathrm{pm.}^{1}}$ and $\overline{\mathrm{m.}^{1}}$.

Again, if the upper milk and permanent carnassials be compared, it will be seen that in the latter *three* external cusps are present, the posterior being the cingulum-cusp, whereas in the former the division of the Metacone into two cusps is not so clearly distinguishable. In the second functional deciduous premolar ($\underline{\mathrm{dpm.}^{2}}$) there is but the very faintest indication of a second cusp externally, which is very much more marked in its permanent successor. The same thing is to be noted in the lower jaw, but in a lesser degree. From these considerations it will be seen that the teeth of the permanent dentition show an increase both in the number and size of the cusps over the corresponding milk-teeth; in other words, the teeth of the deciduous are simpler than those of the permanent dentition. This fact is still more strikingly shown if the biting-surface of the crowns of the teeth be examined. In fig. 3 is shown the biting-surface

Fig. 3.



A, the biting-surface of First Permanent Molar, and B, of the Fourth Deciduous Premolar of the Dog.

of $\underline{\mathrm{dpm.}^{4}}$ and $\underline{\mathrm{m}^{1}}$ of *Canis familiaris*; in the former there are indications of *four* cusps, whereas in the latter *seven* are to be seen.

But this comparison brings out another very important fact. I think it will be generally admitted that the cusp (*pr*) in $\underline{\mathrm{m.}^{1}}$ is the Protocone; and on comparison with $\underline{\mathrm{dpm.}^{4}}$ it will be seen that in the latter this cusp, the *Protocone*, is *entirely* absent.

This conclusion I think is very damaging to the Tritubercular theory as I understand it.

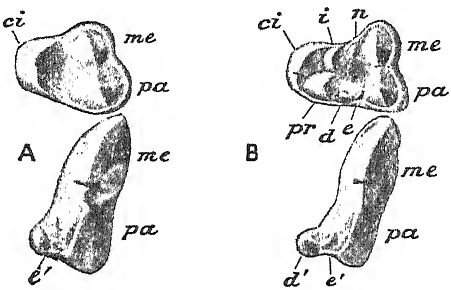
The difficulty in homologizing the Protocone in the various teeth of *Canis familiaris* has already been pointed out, but it is

still further increased by a comparison of the teeth in this Dog with the corresponding teeth in other members of the Canidæ.

If pm.⁴ and m.¹ of the Jackal (*C. aureus*) be examined and compared, it will be seen that, if any reliance is to be placed upon the homologies of cusps, there is present a very marked difference.

Firstly, there is a large well-marked cusp (fig. 4 B, *pr*) forming

Fig. 4.



A. The biting-surface of the Fourth Premolar and First Molar Teeth of *Cyon rutilans*. B. Similar view of the corresponding teeth of *Canis aureus*.

with the two external cusps (*pa* and *me*) a complete triangle present on the biting-surface of the crown of m.¹ This cusp is the one, I presume, the Trituberculist would regard as the Protocone. Situated antero-externally to this is a second cusp (*d*), and between this and the Paracone (*pa*) is another small cusp (*e*) placed on a somewhat prominent ridge passing between cusp *d* and the Paracone. On comparing the crown of this tooth with that of the upper carnassial, it would appear that the two cusps (*d'* and *e'*) present on the inner part of the tooth are homologous with the cusps *d* and *e* of the molar tooth, and that the cusp *pr* of the latter tooth, the all important Protocone, is absent entirely from pm.⁴.

If, again, the upper carnassial tooth of *C. aureus* be compared with the corresponding tooth of such a form as *Cyon rutilans*, or even with many examples of the common Dog, it will be seen that the cusp *d'* present in *C. aureus* appears to be absent in *Cyon rutilans* (fig. 4 A), and that the only trace of a cusp on the inner side of pm.⁴ in the latter animal seems to be homologous with the cusp *e'* of the Jackal.

I would here draw attention to the great similarity between

$\underline{\text{m.}1}$ of *Cyon rutilans* and $\underline{\text{dpm.}^4}$ of *Canis familiaris*, a point which will be referred to subsequently. Compare fig. 3 B and fig. 4 A.

It may be urged that the first molar and the fourth premolar belong to an entirely different series, and are not in any way comparable. Such an objection has, I believe, never been raised by any of the supporters of the Tritubercular theory; they have always regarded these teeth as tritubercular derivatives (2), and therefore, I think, one is quite justified in attempting to homologize these various cusps.

If this be allowed, then, I think it must be said that the Protocone of the molars is not represented in the premolars of a form like the Jackal, and that this is still more accentuated in *Cyon*. Consequently, if we are to interpret the anterior premolars in the light of the fourth of the series of the upper *six* cheek-teeth, the *four* premolars would appear to have the all important Protocone wanting.

From these considerations I cannot but think that the greatest doubt is thrown upon the Tritubercular theory by a careful study of the cusps themselves in the various teeth.

Microscopical Examination.

By the discoveries of Flower, Kükenthal, and others the term Monophyodont, in its strictest sense, has become useless, though still employed to designate those animals which have only one *functional* set of teeth.

The Marsupials, the Edentates, and the Cetacea have all histological representatives of at least two dentitions.

In the Dog, indications of three dentitions are to be found, namely, the Milk, Permanent, and Post-permanent; the last being especially well-marked in the region of the third upper incisor of an animal about three weeks old (27). In all the specimens that I have examined, including a fœtus as early as the seventh week, I have been unable to find any trace of a Pre-milk dentition.

Evidences of the Post-permanent dentition have also been adduced by Leche (10) and Kükenthal (8) in the Seal, Röse (21) in Man, and M. F. Woodward (29) in *Erinaceus*. Three dentitions are thus represented in all these animals. The same number is found represented in the Marsupials, but these Leche has referred to a Pre-milk, Milk, and Permanent. He was led thus to regard them from the fact of the functional dentition of

the Marsupials being supposed to be the milk series; and this conclusion was based on the fact that Kükenthal had discovered strong swellings of the dental lamina on the lingual side of these teeth in *Didelphys* (9).

In the absence of any evidence of four dentitions being represented in any one part of the jaw of any animal, it seems to me to be only reasonable to infer that the three dentitions of the Marsupials are the same as those represented in the Seal, Man, Hedgehog, and Dog; and, consequently, I would regard Leche's Pre-milk dentition as the vestigial remains of the milk series and the functional set as belonging to the true permanent series, thus reverting to the view long ago held by Flower and Oldfield Thomas. The formerly vexed question as to which is the superadded dentition, the Milk or Permanent, is no longer a serious one, as the three dentitions are an inheritance from polyphyodont ancestors.

The next question arises, to which dentition do pm.[1] and the true molars belong? since they are functional in one series only. If sections of an animal three days old be examined, in the region of the first premolar tooth, three downgrowths of the dental lamina are to be seen, and it is from the central one of these that the tooth develops (27). Regarding these three downgrowths as representing the same three dentitions found in the outer incisor region, I would consider this first premolar tooth as belonging to the Permanent or Successional series. This conclusion is, I think, in harmony with that of the majority of observers; but there are some who prefer to regard it as a delayed milk-tooth. This tooth is replaced in one or two animals only, namely, the Indian Taper (19), the Hyrax (3), occasionally the Pig (12) and Rhinoceros, and the extinct Palæotherium (4). In these cases the two teeth may be of the milk and permanent, or of the permanent and post-permanent series. I am not as yet in a position to say anything definite upon this point, though, from the appearances of the dental lamina in the Dog and in the Pig, I incline to the latter view.

With regard to the true molar teeth opposing views have also been held, namely, that they are permanent teeth, or that they are delayed milk-teeth. Hoffmann (6) has recently concluded that the Ungulate molars belong to the milk series; and Leche (10), though admitting that this is by no means settled, is inclined to the same opinion.

If, however, my aforementioned conclusions with regard to pm.[1] be accepted, it must I think be concluded that the molars belong also to the permanent series. If the molar region of a fœtal pup be examined at about the seventh week, the tooth will be seen developing, and there is a slight trace of the dental lamina on its labial side. At a later period, after birth, this labial downgrowth has disappeared, the tooth itself is well developed, and, in addition, there is a strong downgrowth of the dental lamina on the lingual side. Here then, again, are evidences of three dentitions, from the central one of which the molars develop; and, consequently, I regard them as belonging to the permanent series.

Again, it is a very curious but well-known fact that in the upper jaw of the Dog the characters of the last deciduous premolar are similar to those of the first true molar, and those of the penultimate deciduous premolar to those of the permanent carnassial; that is to say, that the specialized carnassial tooth is preceded in position by a tooth molariform in character.

If the last deciduous premolar of a Dog, about three days old, be examined in serial sections, we find a condition identical with that already described in the fœtal condition of the true molar region: namely, a labial downgrowth of the dental lamina, a central one from which this deciduous tooth is developed, and a lingual downgrowth (27). This last downgrowth ultimately disappears, the permanent carnassial developing *anteriorly* and altogether independently of it.

The conditions in the case of this last deciduous premolar being the same as in the case of the true molars, the conclusion must be the same; that is to say, that this deciduous tooth belongs to the same series as the true molars, which it resembles in characters, and that its successor in position, the permanent carnassial tooth, is not its true morphological successor, that successor not developing *.

There here arises the question, to what dentition is the permanent carnassial to be referred? Does it belong to the permanent series; or is it, owing to its great development, a delayed milk-tooth, as my friend Mr. M. F. Woodward has suggested?

In a seven weeks' fœtal pup we find the developing tooth (fig. 5,

* This is in agreement with the conclusion by M. F. Woodward for the Insectivora, in Brit. Assoc. Reports, Ipswich, 1895, p. 736.

pm. 4′) with a *labial* downgrowth of the dental lamina (pm. 4″). I would here digress to remark on the peculiarity of this downgrowth. It assumes at its free extremity a well-marked spherical shape, the epithelial cells becoming concentrically arranged, the central ones having a translucent appearance. It is distinctly connected with the dental lamina. Mr. Woodward tells me he has found a similar structure, in precisely the same situation, in

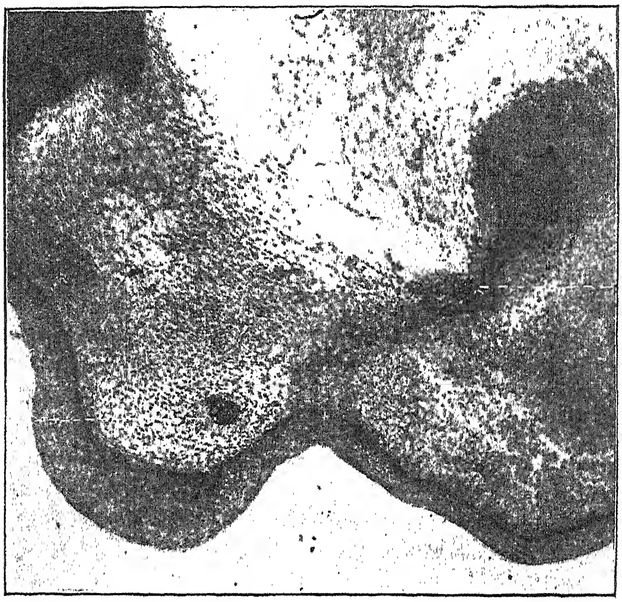


Fig. 5.—Transverse section through the developing Upper Carnassial of the 7 weeks' fœtal Pup.

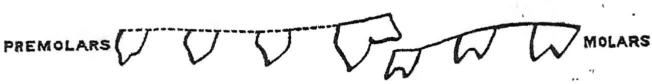
Gymnura. I am not able to give an explanation of the condition, but from the facts of its connection with the dental lamina and its presence in precisely the same situation in these forms, I do not think it is a chance structure, and it is possible that it may represent the remains of the predecessor to this tooth which has taken on this peculiar character. The point is, however, I think, worth further investigation.

At a later period in the development of this tooth a well-marked lingual downgrowth of the dental lamina is to be seen, and thus the conditions of its development are identical with those found in the development of the molars.

From these considerations I am of opinion that the upper permanent carnassial does really belong to the so-called Permanent dentition; and that by the great development and extension backwards and upwards of the Metacone the anterior molar has been pushed downwards so as to cut the gum with the milk-teeth.

These facts are of additional interest in that they may afford an explanation of the somewhat similar condition found in some of the Marsupials, in which the posterior premolar alone replaces in position a tooth molariform in character. This deciduous tooth has been regarded as the only one "comparable to the milk-teeth of the Eutheria" (4); and the study of its relationships led Flower and Thomas to regard the functional set of the Marsupials as belonging to the permanent series.

Since Kükenthal's discoveries in the Didelphyidæ (9), this succession has been explained otherwise. The dentition of the Marsupials is now regarded as a persistent milk series, this tooth alone having a permanent successor. I have given reasons above for reverting to the former view; and the fact that this tooth alone is replaced is explained by the entire absence of any functional milk-teeth. I regard this single deciduous tooth as in reality the anterior molar pushed downwards by the overlapping as it were of the premolars and molars at this point, due possibly in the first instance to the gradual shortening of the jaw, and assisted, as in the Carnivora, by the greater development of the Metacone, which by its extension upwards and backwards would tend to force the first molar through the gum. This may be represented diagrammatically in this way:

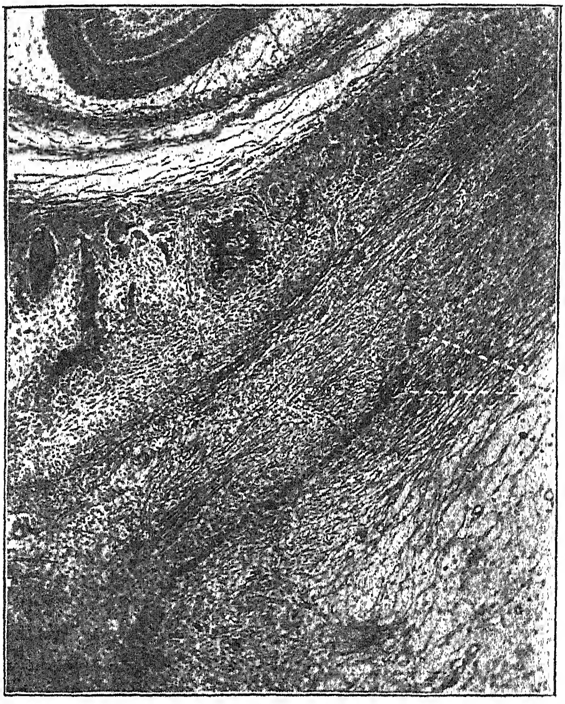


In cases where the first of the two factors (namely the shortening of the jaw) is alone in operation, the result would be simply to delay the appearance of the successional tooth, as is seen in such forms as *Potorous*; but when the additional factor (namely the extension backwards of the Metacone) comes into play also, the result would be that the deciduous tooth would be shed at an earlier age—that is, it would be accelerated, as is the case in *Thylacinus* and the Carnivora.

The next point of interest in the microscopic examination of

these specimens is whether there is any evidence of the previous existence of additional teeth, and in this connection there are two points which may be mentioned.

(i.) In the incisor region of the upper jaw the dental lamina between $\underline{\text{i.}}^3$ and $\underline{\text{c.}}$ maintains a position extending well down into the substance of the jaw, and does not shorten up as it does between any two of the other teeth. Midway between these



i.^{4}

Fig. 6.—Section through the region posterior to the Third Upper Incisor of a 12 hours' Pup, showing apparent vestigial Fourth Incisor.

teeth there is a slight enlargement, somewhat forked (fig. 6, i.^{4}), which only extends through a few sections. The position of the dental lamina might be explained by the great development of the canine retaining it deeply in the jaw; but if it were due to this, one would expect to find the same condition behind the canine as well, which is not the case. It is possible that there is here present the vestigial remains of a fourth upper incisor, though the facts are not conclusive.

(ii.) Behind the last upper molar the dental lamina is continued backwards for some distance; it gets considerably distorted and broken up; but one part of it is more enlarged than the rest. The facts do not allow one to speak with any certainty, but I think it is possible to recognize in it the vestigial remains of a third upper molar, since I can find no trace of such remains in the corresponding position in the lower jaw.

Numerical Variation of the Teeth of the Carnivora.

The number of teeth present in the permanent dentition in living Mammalia varies greatly, and though this variation is somewhat narrower among the Carnivora still it is far from being uniform. This is shown in the accompanying Table (p. 462), which I have compiled from Flower and Lydekker's 'Mammalia,' and certain points, which are worthy of note, may be readily seen.

(i.) *Æluroidea.* The maximum number of teeth present among the members of this group is 40, the Felidæ and Proteleidæ falling as low as 30.

(ii.) *Cynoidea.* The teeth vary from 40 in *Cyon* to 46 or 48 in *Otocyon*; the Canidæ possessing 42.

(iii.) *Arctoidea.* The Mustelidæ have the smallest number (38), while the Ursidæ have 42.

From this it will be seen that the maximum numerical variation is attained among the Æluroidea, the minimum by the Arctoidea, while the Cynoidea occupy an intermediate position; and, moreover, by far the greater number of its members have the same number of teeth, 42. This, I think, justifies the well-established deduction that the ancestral form had 42 or more teeth. It was also probably Pentadactyloid and Plantigrade. These three characteristics are present among the living Ursidæ.

To effect the numerical variations one of two things must have happened—(i.) either teeth must have, in some instances, been superadded, causing an increase in the number; or (ii.) some teeth must have become suppressed. I think the balance of evidence is decidedly in favour of the latter, for the following reasons:—

(i.) Supernumerary teeth, of which examples are given by Bateson (1) in his book 'Materials for the Study of Variation,' are very rare; and the number is never in excess of that found among fossil forms, and may be regarded as "reversions to a

TABLE I.

Giving a General Survey of the more typical Dental Formulæ of the Carnivora.

CARNIVORA VERA.

- **Æluroidea**
  - (α) *Felidæ.* $\frac{3\,1\,3\,1}{3\,1\,2\,1}=\mathbf{30}$.
  - (β) *Viverridæ.* $\frac{3\,1\,(3 \text{ or } 4)\,(1 \text{ or } 2)}{3\,1\,(3 \text{ or } 4)\,(1 \text{ or } 2)}$
    - (i.) *Cryptoprocta.* $\frac{3\,1\,4\,1}{3\,1\,4\,1}=\mathbf{36}$.
    - (ii.) *Viverrinæ.* $\frac{3\,1\,4\,2}{3\,1\,4\,2}$ ($\frac{1}{2}$ m. in *Prionodon*)$=\mathbf{40}$.
  - (γ) *Proteleidæ.* i. $\frac{3}{3}$, c. $\frac{1}{1}$, p.+m. $\frac{4}{3 \text{ or } 4}=\mathbf{30}$ or $\mathbf{32}$. Premolars and molars very small and simple.
  - (δ) *Hyænidæ.* $\frac{3\,1\,4\,1}{3\,1\,3\,1}=\mathbf{34}$. Some fossil forms have m. $\frac{1}{2}$ or $\frac{2}{2}$.
- **Cynoidea**
  - (α) *Canidæ.* $\frac{3\,1\,4\,2\text{–}3}{3\,1\,4\,2\text{–}4}=\mathbf{40\text{–}44}$.
  - (β) *Cyon.* $\frac{3\,1\,4\,2}{3\,1\,4\,2}=\mathbf{40}$.
  - (γ) *Otocyon.* $\frac{3\,1\,4\,(3 \text{ or } 4)}{3\,1\,4\,4}=\mathbf{46}$ or $\mathbf{48}$.
- **Arctoidea**
  - (α) *Ursidæ.* $\frac{3\,1\,4\,2}{3\,1\,4\,3}=\mathbf{42}$.
  - (β) *Procyonidæ.* $\frac{3\,1\,4\,2}{3\,1\,4\,2}=\mathbf{40}$.
  - (γ) *Mustelidæ.* $\frac{3\,1\,4\,1}{2\text{–}3\,1\,4\,1\text{–}2}=\mathbf{36\text{–}38}$.

regularity" (*Darwin*); while examples of numerical reduction are comparatively common.

(ii.) Embryology has brought to light the presence of vestigial remains of additional teeth. Such examples have been furnished by Oldfield Thomas (26) and M. F. Woodward (30) among Marsupials, and I have already given reasons for believing that the same are probably present in the Dog.

One has only to look at such a table as that accompanying Oldfield Thomas's (26) paper to see how very general is such a suppression.

(iii.) Palæontological evidence shows that a large number of Mesozoic Mammals had a greater number of teeth than the majority of those living. That the tendency to the suppression of teeth has been in operation in past ages is amply testified by Osborn (14) in his paper "On the Structure and Classification of the Mesozoic Mammalia." In this paper he gives the dental formula of the primitive heterodont Mammalia as i. 4, c. 1, pm. 4, m. 8 (p. 249); and he goes on to say, "Reduction of this formula was effected by the loss of the lateral incisors, resulting possibly from the hypertrophy of the adjoining canine; the premolars were reduced by regular antero-posterior suppression, or by the loss of the first or second member of the series; the molars were reduced either by antero-posterior or by postero-anterior reduction or by simultaneous reduction of both ends of the series."

And (iv.) if the Mammalia are descended from Reptilian ancestors, as is generally believed, then certainly a reduction in the number of teeth, as well as in the number of dentitions, must have taken place.

From these reasons it is possible to conclude, other things being equal, that the member of a mammalian group which has the greatest number of teeth retains, in that particular, the more primitive condition. If this be so, then I think we must regard the Ursidæ among the Arctoidea, the *Viverrinæ* (with the exception of *Prionodon*) among the Æluroidea, and *Otocyon* not only among the Cynoidea, but among the whole Carnivora, as retaining the most primitive condition as to the number of their teeth, which in the last-named genus is 46 and in one specimen 48. That *Otocyon* is in this respect the most primitive, among the Cynoidea, was a view long ago held by Huxley (7).

Cope, in his paper "On the Mechanical Origin of the Sectorial Teeth of the Carnivora" (2), remarks "it is well known that in the evolution of the sectorial dentition of the Carnivora the number of molars and premolars has considerably diminished."

It has been said (4), in connection with the primitive dentition of *Otocyon*, that "there is at present no palæontological proof of this, as none of the numerous fossil forms of Canidæ yet discovered have more than the normal number of molars." I would point, in answer to this, to such a form as the Oligocene *Daphænus* with a dental formula $\frac{3143}{3143}=44$, which, according to W. B. Scott (24), is in the direct line of ancestry of the Dog. This genus differs from the specimens of *Otocyon*, with the single exception above referred to, in the loss of one lower molar only. If we look at all the members of the Carnivora in which the number of molars is not equal in both jaws, it will be seen that the number is always greater in the lower jaw, from which one might infer that the upper molars were the first to undergo numerical reduction; and from this it follows that, given an equal number of true molars in both jaws, if any teeth have undergone suppression, the last tooth to have been suppressed would be in the lower jaw. If this inference be allowable, then we may presume that one of the more immediate ancestors of *Daphænus* had an additional lower molar, the loss of which alone distinguished it from *Otocyon*.

That the Canidæ very early acquired a reduced dentition is a fact, and it is, I think, in accordance with their great number and wide distribution both at the present time and in past ages; and, conversely, the retention by *Otocyon* of a primitive dentition agrees with its restricted area of distribution, one species (*O. megalotis*) only being known.

From these considerations I am the more inclined to the opinion that in *Otocyon* we have to do with a form in which a very primitive numerical condition of the teeth has been retained.

Description of the Permanent Teeth of Otocyon megalotis.

Upper Jaw.—The first and second incisors are very similar to those of the Dogs generally. Between the $\underline{\text{i.}}^2$ and $\underline{\text{i.}}^3$ is a slight diastema.

The *third incisor* is somewhat larger than the others. It has a cingulum on

its internal face which runs upwards, at the margins of the tooth, to the apex of the crown. Between this tooth and the canine is a wide diastema.

The *canine* is long, pointed, and recurved, and shows a similar condition of the cingulum on its internal face. Between this tooth and $\underline{\text{pm.}^1}$ is a very wide diastema.

The *first premolar* is much reduced and with but a mere trace of an internal cingulum. The posterior margin of the tooth shows a slight angulation which in the more posterior premolars appears as a minute cusp. Between this tooth and $\underline{\text{pm.}^2}$ is a distinct diastema.

The *second premolar* is rather larger than the first and has two fangs. A minute cusp is to be seen at the posterior border formed by the internal cingulum which runs into it. The cingulum is also more noticeable on the inner face of the anterior root; that is, in the position of the Protocone.

Slight diastema between $\underline{\text{pm.}^2}$ and $\underline{\text{pm.}^3}$

The *third premolar* has characters similar to those of the second but more marked, as it is a somewhat larger tooth.

The *fourth premolar* has a main cone with a well-marked cusp anteriorly and another posteriorly to it. There is a very well-marked ridged cingulum on the internal face of the main cone, which leads up to and forms the anterior and posterior cusps. The Protocone is large, almost as high as the main cone, and placed in the same transverse line. *It is distinctly a cingulum-cusp.*

On the ridge of the cingulum, leading from the Protocone to the posterior cusp, is another small cuspule placed somewhat nearer to the Protocone. On the posterior slope of the main cone of the tooth is seen a minute cusp, distinct from the posterior cingulum-cusp, which is, however, more marked in $\overline{\text{pm.}^4}$. A slight trace of the cingulum can be seen on the outer face of $\underline{\text{pm.}^4}$.

The *first molar* has two external cusps of about equal size. The cingulum is seen anteriorly and posteriorly to these and also slightly on the external face, especially of the anterior cusp (Paracone), where it becomes continuous with the Protocone. The cusp situated between the Protocone and the posterior part of the cingulum (seen in miniature in $\underline{\text{pm.}^4}$) is well-marked.

Internally to this again is a secondary cingulum, upon which is placed a pronounced postero-lingual cusp, in front of which the secondary cingulum shelves downwards and forwards; it then bifurcates, one part running into the Protocone, the other passing round in front of it to fuse with the primary cingulum, externally to the Protocone.

The *second molar* has similar characters to $\underline{\text{m.}^1}$, but the Paracone is higher and more pointed than the Metacone.

The *third molar* is of the same pattern but is a smaller tooth, and therefore the individual cusps are not so clearly differentiated.

Lower Jaw.—Incisors small and more procumbent than in the Dogs generally. All are about equal in size.

No diastema between $\overline{\text{i.}^2}$ and $\overline{\text{i.}^3}$.

The *third incisor* has a well-marked internal cingulum rising into two small cusps at its extremities, but from the position of the tooth they lie more on the internal face than laterally.

Practically no diastema between $\overline{\text{i.}^3}$ and $\overline{\text{c.}}$

The *canine* is smaller than $\underline{\text{c.}}$ Internal cingulum present.

The *first, second, and third premolars* possess similar characters to the corresponding teeth in the upper jaw, with the addition that in $\overline{\text{pm.}^3}$ the anterior cingulum-cusp is more pronounced.

The *fourth premolar*. The main cusp has a well-marked secondary cusp on its posterior slope. The cingulum is not very distinct in the middle of the inner face of the main cone; but anteriorly it gives rise to a cusp, and posteriorly, where it becomes broader and more prominent, it forms two small cusps which are situated transversely side by side.

First molar. Outer surface. Two cusps are to be seen, an antero-external (Protoconid), which is higher and stronger than the postero-external (Hypoconid).

Inner surface. Two cusps also, an antero-internal (Metaconid) and a posterior (Entoconid) cusp, the former being the higher.

Anterior surface. The Paraconid, which has more of the character of a transversely elongated ridge than a cone.

Posterior surface. The cingulum is to be traced around the bases, posteriorly, of the Entoconid and Hypoconid, and opposite the interval between these two cusps is the Hypoconulid, placed on the cingulum.

At the antero-external angle of the tooth is a small secondary cingulum, which becomes lost upon the anterior surface of the Paraconid.

The *second molar* has the same pattern as the first, the differences being that the Metaconid is more developed than the Protoconid; the Paraconid is more pronounced than in $\overline{\text{m.}^1}$.

The secondary cingulum at the antero-external angle of the tooth is more marked and bears a cusp, in consequence of which the Protoconid appears to lie more towards the middle (antero-posterior) line of the tooth.

The *presence of this cusp on the external cingulum* is a fact upon which I wish to lay stress, and to which I shall again refer.

The *third molar* has the same characters, but smaller. Paraconid still more reduced.

The *fourth molar* is much smaller. Paraconid scarcely visible.

I have given reasons above for believing that *Otocyon* is primitive in respect to the number of its teeth, and I think it will readily be admitted, from a consideration of the teeth themselves, that they possess decidedly multituberculate characters. The question once more arises, Is this multituberculate condition primitive or not? The consideration of the answer to this question has an important bearing upon the theory of the multituberculate origin of the Mammalian teeth, as put forward by Forsyth Major (11), and supported by Goodrich (5) and others.

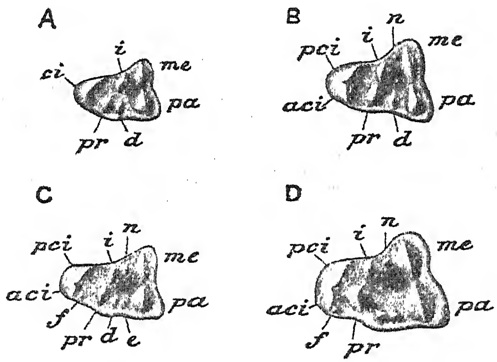
In dealing with this question it is necessary to here examine the teeth of various species of Dogs. This I have had an oppor-

tunity of doing through the kindness of Mr. Oldfield Thomas, to whom my best thanks are due for having allowed me to have free access to the specimens in the British Museum. In carrying on this part of my investigation I have taken Huxley's monograph, "On the Cranial and Dental Characters of the Canidæ" (7), as my guide.

In this paper Huxley divided the Canidæ primarily into two series, the Thooid and Alopecoid, and arranged several of the members in each series in a fairly definite order of specialization, distinguishing the Macrodont from the Microdont forms.

It will not be necessary to take each member of the series individually. Commencing with the Thooid series, it will be sufficient to examine *C. Azaræ* (817 A), *C. cancrivorus* (46. 1. 28. 57), *C. magellanicus* (184 *b*), *C. anthus* (816 *a*)*.

Fig. 7.



The biting-surface of the First Right Upper Molar Tooth of—A. *Canis Azaræ*; B. *C. cancrivorus*; C. *C. magellanicus*; D. *C. anthus*. (Thooid Series.)

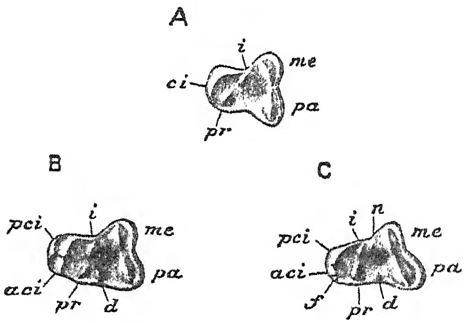
Fig. 7 delineates the crown of the *first right upper molar* in each of these forms. *C. Azaræ* (A) and *C. cancrivorus* (B) belong to the Microdont series, and have the fewest cusps, the former having *six* and the latter *eight*; whereas *C. anthus* (D) (which with *C. aureus* belongs to the Macrodont series) has ten cusps. The measurements of *C. magellanicus* (C) appear to vary, but working out the measurements given by Huxley (*op. cit.* p. 267), it

* These numbers refer to the particular British Museum specimens from which the drawings were taken.

also would certainly belong to the Macrodont series and it has likewise *ten* cusps. The same increase in the number of cusps may be seen in the lower carnassial teeth in members from opposite ends of the series. I would also draw attention to the increase in size of the external cingulum in passing up the series; indeed, in *C. anthus* it forms a projection at the antero-external angle of the tooth, nearly half the height of the Paracone itself. This I regard as an important point, as I have already shown that cusps are formed on it in *Otocyon*. The same condition is also to be seen in some of the Insectivora—a condition which, I believe, should necessitate reconsideration of the interpretation of the cusps in some of those forms which are regarded as having typically tritubercular teeth.

The same increase in the number of cusps may be noted in the Alopecoid series. In fig. 8 are shown the biting-

Fig. 8.



The biting-surface of the First Right Upper Molar tooth of—A. *Canis littoralis*; B. *C. niloticus*; C. *C. lagopus*. (Alopecoid Series.)

surfaces of the first right upper molar of *C. littoralis* (*C. virginianus*, Mivart) (88. 11. 25. 2), *C. niloticus* (56. 3. 12. 14), and of *C. lagopus* (88. 2. 20. 12). *C. littoralis* is one of the lower Microdont Alopecoid dogs, while the two latter belong to the Macrodont series, and in these more cusps are present than in *C. littoralis*.

This conclusion has been arrived at after a very careful study of the large number of skulls of the Canidæ preserved in the British Museum. In some cases the teeth were too worn to afford very reliable information; I was therefore led to select

individual skulls, in which the tooth-cusps were more complete (*i. e.* least worn), for special illustration, but the general conclusion was in entire accordance with the view just stated.

The outcome of these considerations, with regard to *Otocyon*, is—that it is primitive in respect to the number, but specialized in respect to the multituberculate condition of its teeth.

These conclusions are apparently in direct contradiction to those arising out of the study of the genus *Cyon*. The members of this genus are distinguished from the true Dogs chiefly by the loss of the last lower molar. I have already drawn attention to the fact of the great simplicity of $\underline{\text{m.}^1}$ of *Cyon rutilans*, a tooth more primitive even, according to my views, than $\underline{\text{dpm.}^4}$ of the Dog.

I am not in a position to do more than suggest, as a possible explanation, that the genus *Cyon* became separated off from the true Dogs at an early period, and that its teeth, while retaining the simplicity of their crowns, have undergone numerical reduction. These animals also differ from the ordinary Wolves, Jackals, and great majority of domestic Dogs, according to Huxley (7), in the breadth of the jaws and the convexity of the facial line. I would emphasize the great resemblance which exists, both in the number and pattern of the teeth, between the members of this genus and *Viverrinæ*, as tending to the suggestion that they have all descended from a common stock, early separated from the true Canidæ.

Embryological Evidence as to the order of Cusp-development.

The value of evidence of this nature is based upon the assumption that Ontogeny recapitulates Phylogeny. Of course this assumption may be doubted, but it is interesting to note that Osborn, a great upholder of the tritubercular view, believes in it strongly, as may be gathered from the following. In an address "On the History of the Cusps of the Human Molar Teeth," delivered before the New York Institute of Stomatology in April 1895 (15), occur the following words:—"We should expect, in the embryonic jaw, that the calcification of the tooth-germ would be very significant, because we know that the embryonic structures in their development follow the order of addition or evolution." Having made this definite statement, in the next sentence he makes a partial retraction by saying, "The order of

evolution is, *to a certain extent*" (the italics are mine), "repeated in embryonic development." However, we can gather from this that Osborn admits the validity of the assumption.

Upon this basis, let us see how the facts may be reconciled with the tritubercular theory. According to this, the Protocone should be developed first, and the Paracone and Metacone almost simultaneously but at a later period, and the talon, or heel, still later. This is the order in which the various cusps have arisen, according to Prof. Cope (2); consequently this is the order in which they should appear ontogenetically.

The cusp-development has been worked out by Röse (22) in the Primates and Marsupials, and by Taeker (25) in the Ungulates. Their results are seen in the accompanying Table (II.), copied

TABLE II.

UPPER MOLARS.

	Primates.	*Marsupials.*	*Ungulates.*	
1.	Paracone.	Paracone.	Paracone.	1.
2.	Protocone.	Protocone.	Metacone.	2.
3.	Metacone.	Metacone.	Protocone.	3.
4.	Hypocone.	Hypocone.	Hypocone.	4.

LOWER MOLARS.

1.	Protoconid.	Protoconid.	Protoconid.	1.
2.	Metaconid.	Paraconid.	Metaconid.	2.
3.	Hypoconid.	Hypoconid.	Hypoconid.	3.
4.	Entoconid.	Entoconid.	Entoconid.	4.
5.	Hypoconulid.	Metaconid.		

from a paper by Osborn (13), and with them my own results, as seen in the Dog, are in agreement. From a study of this table the most striking fact is revealed that while in not one of the four orders does the Protocone develop first, the Protoconid does so in every instance. This is a very important point.

In the above-mentioned address by Osborn (15), the fact of the agreement in the lower jaw and disagreement in the upper jaw is thus referred to; he says:—"In the lower molar teeth the order of calcification is precisely the order of evolution;" and after dealing with this order of development, he goes on to say: "So we find that the order of embryonic development exactly repeats the order of historical development, and in every way presents the strongest kind of confirmation of the theory of cusp-formation which we have been discussing." He omits to mention that the Paraconid does not develop at all.

Of course Osborn is dealing here with the human teeth only: otherwise, if he were dealing with the Marsupials as well he could hardly be so satisfied, for in these the Metaconid, instead of developing almost simultaneously with the Paraconid, does not appear until after the Hypo- and Entoconid.

In the same address, in dealing with the upper jaw, Osborn says so little, that I may quote it all:—"But this, you see, is not exactly the case in the upper molars. Nevertheless, out of eight cusps in the upper and lower molars considered together, *six* cusps calcify in the order in which they were successively added to the single reptilian cone." Surely this representative of the reptilian cone is *the* important one, and the fact that it does not develop first in any one of these four orders is a point not easily to be explained away.

Again, it appears to me that Osborn gives undue weight to the lower jaw, almost ignoring the upper, which does not fit in with his views. I would point out that in the Canidæ the secondary cusps are better developed in the teeth of the lower jaw than in the corresponding teeth of the upper, both in the milk and permanent dentitions; and I have already pointed out that the more primitive the teeth the fewer the cusps: consequently, it follows that the teeth of the upper jaw retain more of the primitive character than do those of the lower. Hence, if reliance is to be placed on the cusp-development of the teeth in one jaw over those of another, it is the upper jaw which, to my mind, should be selected, and not the lower.

From a consideration of the results obtained by investigation into the embryological history of the cusps, I think it must be admitted that Osborn's conclusions are not borne out, but are, on the contrary, disproved, and this by the very kind of evidence upon which he places reliance.

There are still other objections which may be urged against the Tritubercular theory. The upholders of this view assume that there has been a rotation of the Paraconid and Metaconid inwards in the lower jaw and outwards in the upper, giving rise to the Tritubercular as opposed to the Triconodon type of tooth. A great objection to this has been put forward by E. S. Goodrich (5), who points out that there is no evidence whatever of any traces of the beginning of the movement of cusps from the Triconodont to the Tritubercular form.

It may be as well to summarize the arguments which may be now urged against the Tritubercular theory:—

(i.) That in not one of the four orders, Marsupials, Ungulates, Carnivora, or Primates, does the Protocone develop first.

(ii.) That in *two* out of the four orders it does not even develop second, being preceded by the Metacone.

(iii.) The frequent absence of the Paraconid.

(iv.) That in the Marsupials the Metaconid, which, together with the Paraconid, is second in importance only to the Protoconid, is developmentally preceded by the Hypoconid and Entoconid.

(v.) That if the homology of the cusps which I have already attempted to give be correct, it follows that the Protocone is absent from all the teeth of the Canidæ, and, I think it may be added, from all the teeth of the Carnivora, with the exception of the true molars.

(vi.) That the Protocone is absent from the molariform $\underline{\text{dpm.}^{4}}$ of the Dog, a tooth of exceedingly primitive characters.

(vii.) The absence of the Protocone from the $\underline{\text{m.}}^{1}$ of such a form as *Cyon rutilans*, this tooth, as I have already pointed out, having characters very similar to $\underline{\text{dpm.}^{4}}$ of the Dog.

(viii.) The absence of any evidence of the commencement of the movement of rotation of the cusps, such as is presumed to have taken place; and

(ix.) The existence of the Multituberculata at such an early geological period.

In addition to these, several very weighty objections have been forcibly urged by Dr. Forsyth Major in his paper on the Miocene Squirrels (**11**).

Another theory to account for the tooth-genesis of the Mammalia is that which was advanced by Forsyth Major (**11**), and supported by Goodrich (**5**) and others, and is known as the Multitubercular theory.

These authors would derive all teeth from the Multituberculate type; but I think there are strong objections to this view also, for the following reasons:—

(i.) This view does not attach any special importance to any one cusp over another; and yet we find that the antero-external cusp always develops first both in the upper and lower jaws, the other cusps being added subsequently in a more or less

definite order, and not that several cusps appear at first and subsequently some become suppressed.

(ii.) All the fossil Multituberculata have a specialized dental formula with numerically reduced incisors and no canines: consequently I am unable to believe that the Carnivora and Insectivora, with their full dental formulæ, have been derived from these.

(iii.) That there is a progressive increase in the number of cusps in both the Thooid and Alopecoid series of Dogs, in passing upwards from the more primitive forms.

(iv.) That the teeth of the deciduous dentition are more primitive than those of the permanent and have fewer cusps.

(v.) Goodrich remarks that "Multituberculate forms increase in number the lower we search:" this increase, of which I am unable to convince myself, must be very small, and the total number found at present is greatly below that of non-multituberculate forms, and of equal, but not greater antiquity.

Such forms as *Otocyon*, which I consider to be primitive in the number of its teeth, have, I believe, secondarily acquired the multituberculate condition. The Monotremes may be directly descended from the Multituberculata, as may also such orders as the Rodentia with their specialized dental formulæ, though, as I have not specially worked at this point, I am not in a position to express a more definite opinion.

Having thus seen that neither the Tritubercular nor the Multitubercular theory satisfactorily explains the origin of the teeth of the Carnivora, the question naturally arises, Is there any alternative theory that may explain it? I venture to think there is.

In the first place, the history of the development of the cusps shows that the antero-external cone is the first to develop, both in the upper and lower jaws, in all four of the orders to which I have referred. This uniformity cannot be without significance, and I think one must regard this cone as the representative of the primitive reptilian cone*: in other words, I would regard the Paracone and Protoconoid as homologous cusps, and to avoid confusion I would term this the primary cone. The

* This conclusion appears to be in accordance with the views of Winge (28). From his illustrations he appears to regard the Paracone as homologous with the Protoconid, and the Metacone with the Hypoconid.

next structure to which I attach great importance is the internal cingulum. We have already noted its constant presence. That it is a structure of great antiquity is proved both embryologically and palæontologically. If the teeth of a fœtal pup be examined the cingulum is, proportionately to the primary cone, much larger than in the fully-developed tooth. It is also present in some of the fossil Mammalia of the Stonesfield Slate (5); as, for example, *Amphitherium*. The ends of this internal cingulum, which is generally regarded as a mammalian characteristic, give rise to the small anterior and posterior cusps, such as we have seen exist in the incisor teeth of the Dog. Such a form of tooth at once suggests that of the fossil *Microconodon*. In the more specialized cheek-teeth the cingulum, though always more marked internally, is continued round the external face of the tooth, and, as we have seen, may give rise to cusps externally, as in *Otocyon* and possibly some of the Insectivora.

This description of a tooth with a main cone and small anterior and posterior cusps agrees with the description of the premolars of *Amphitherium Prevostii* given by Owen (18). These teeth, he says, "consist of a single compressed conical cusp with a minute tubercle at the hind part of its base and a more minute one in front." We have already seen that in the teeth of the Dog the posterior cingulum-cusp is usually more marked than the anterior. Goodrich (5), in describing the British Museum specimen of *A. Prevostii*, which he has fully exposed, says (p. 414) that the premolars have "a laterally compressed crown bearing one large cusp, a very small anterior cingulum-cusp, and a posterior heel."

The anterior cingulum-cusp does not usually undergo further development. In certain cases, however, in which it does do so, it may form an anterior cone, thus giving rise to a Triconodont tooth. The only teeth in the Dog in which it undergoes development are the deciduous and permanent lower carnassials, giving rise to the cusp usually termed the Paraconid. In these teeth the cingulum runs right up into that cusp, and does not extend forwards as is the case at the posterior end of the tooth. This anterior cingulum-cusp is placed somewhat to the inner side of the primary cone, giving rise to the Protocone of the upper premolars of the Dog and the Paraconid of the lower carnassial.

The posterior cingulum-cusp is usually well-marked, and in

the upper carnassial of the Dog forms the posterior part of the Metacone, and in the lower the posterior (smaller) part of the Hypoconid. Consequently, it will be seen that the *talon* of the lower carnassial appears very early. This is in accordance with the early appearance, geologically, of the trituberculo-sectorial type of tooth. Moreover, Forsyth Major (11) asserts that the talon, though reduced, as compared with the rest of the tooth, in the Carnivora, is well developed in all other orders—therefore, *à priori*, it is not a late development; and he also points to the fact that several Archaic Eutheria, including some Creodonta from the Cernaysian fauna of Rheims, have a more distinctly marked talon than in many later forms, both in longitudinal extension and in height of cusps. Again, Goodrich affirms (5) that we must conclude that the common ancestors of both Placentals and Marsupials possessed this (trituberculo-sectorial) type of tooth.

Following upon this, the next structure to be added is what I propose to term the *Secondary Cone*. It arises upon the posterior slope of the Primary cone, and is of mechanical origin due to contact with the Primary cone of the opposite jaw. This cone is seen in its most rudimentary form in the anterior premolars of the Dog. The more it becomes developed the more the opposing cusp would tend to wedge it backwards and separate it from the Primary cone from which it has been developed. This cone forms the anterior part of the Metacone of the upper carnassial, and the Metacone of the upper true molars. In the lower carnassial it forms the anterior, larger portion of the talon, and postero-external cusp of $\overline{m.}^{2}$. This cusp only develops, to any extent, in the premolars of those forms whose dentition approximates to the Carnivorous type.

Upon the internal cingulum there develops a Centro-internal cusp, situated slightly posteriorly to the middle of the antero-posterior line of the tooth. This cusp is not developed in the premolars of the Canidæ. It forms in the molars the cusp *ci* (fig. 3, B) and gives rise to the Metaconid of the lower carnassial.

As the upper jaw comes to overlap the lower, the opposing cusps would so interlock that the internal cingula of the molars would tend to be wedged inwards away from the main mass of the tooth; the depression thus formed, other cusps would tend to be formed, giving rise to those marked *pr* and *i* in the same figures.

With regard to these smaller cusps it is difficult to express any opinion as to the precise order of evolution, as the results, both palæontological and embryological, are at present somewhat conflicting.

It will be noticed that I have reserved the term *Cone* for that which I regard as the representative of the Reptilian tooth and to its secondary derivative; while the term *Cusp* I have applied to the remainder, all of which I regard as having been developed upon the cingulum.

Table III. gives the order of evolution of the cones and cusps according to this view, and also the cusps with which they correspond, according to the system of nomenclature now in vogue. It will be readily understood that it is impossible fully to deal with this question in a small space, as, from what I have attempted to show above, cusps bearing the same name in different teeth, and even the same teeth in different species, are in reality not homologous. I have therefore confined myself almost entirely to a consideration of the teeth in the Canidæ.

Table III.

Showing the order of development of the Cusps according to the Theory of Cingulum-cusp Development and the Cusps which they represent in the Upper and Lower Jaws of the Dog.

1. Primary Cone	Paracone.	Protoconid.
2. Anterior Cingulum-cusp.	Usually remains minute; forms the Protocone of the upper premolars.	Remains minute in all except the lower carnassial, in which it forms the Paraconid.
2. Posterior Cingulum-cusp.	Forms posterior part of the Metacone.	Minute. Enters into the formation of the Hypoconid at its posterior part.
3. Centro-Internal Cingulum-cusp.	Absent in the premolars. Forms the Protocone of $\underline{\text{dpm.}^4}$ and the *heel* of $\underline{\text{m.}^1}$.	Absent in premolars. Forms Metaconid.
4. Secondary Cone ...	Anterior part of Metacone in the premolars and almost the entire Metacone in the molars.	Anterior part of the Hypoconid and postero-external cusp of molars.

Having thus given a brief outline of what may be termed a Theory of Cingulum-cusp development, it is necessary to examine how far such a theory is borne out by Palæontology and Embryology.

(i.) *Palæontological evidence.*—Starting from the Haplodont

cone, the next form would be that of a tooth with a main central cone and minute lateral cusps. Such teeth are to be found in *Micoconodon.* The prominence of the Internal Cingulum with the formation of a central cusp upon it is clearly to be seen in such teeth as those of *Amphitherium Prevostii* and *Peraspalax*; whilst the presence of the Secondary cone is to be noted in the molar teeth of almost all forms. From the consideration of such forms as these, I think it is evident that Palæontology furnishes quite as strong evidence in favour of such a theory as I have attempted to describe, as it does for either the Tritubercular or Multitubercular theory.

(ii.) *Embryological evidence.*—The strongest confirmation of this view is to be found in the fact that in all the orders in which the cusp evolution has at present been worked out, the Primary cone (Paracone and Protoconid) develops first in every instance, in both upper and lower jaws.

That the Cingulum is a structure of great antiquity and importance is borne out by the fact that it appears developmentally very shortly after the Primary cone can be distinguished. In the teeth of the fœtal Dog it is comparatively very largely developed, especially in the incisors. The internal cingulum is more marked in the lower members of both the Thooid and Alopecoid series than it is in the higher; and its presence, together with the small anterior and posterior cingulum-cusps to which it gives rise, is to be noted in all the teeth of the Dog, both milk and permanent. So far this theory is in accordance with all known embryological facts; the difficulty arises in connection with the secondary cusps. To explain my meaning more fully: if the development of the cusps of $\underline{\mathrm{dpm.}^{4}}$ be traced, the so-called Protocone of that tooth commences to appear before the Metacone, though the latter soon surpasses it in size; this result agrees with those of Röse for the Primates and Marsupials (the teeth in the latter I have given reasons for regarding as milk-teeth); whereas in the development of $\underline{\mathrm{m.}^{1}}$ of the Dog the Metacone develops before the Protocone of *that* tooth, in accordance with Taeker's results in the Ungulates.

A further difficulty is to be found in connection with the Metacone of the upper carnassial teeth of the Carnivora and with the Hypoconid of the lower. We have seen that two factors enter into the formation of both these cusps, namely, the Posterior Cingulum-cusp and the Secondary Cone, but they do

not always participate to the same extent. If, for instance, the carnassial teeth of the Tiger, Dog, and Bear be compared, this fact at once becomes apparent. And since I regard the Posterior Cingulum-cusp as a structure of greater antiquity than the Secondary cone, I conclude that the greater the share which the Posterior Cingulum-cusp takes in the formation of the Metacone, the earlier will that Metacone be developed, and *vice versâ*.

Such is, I believe, the explanation to be given of the somewhat varying results obtained by the aforementioned observers.

I have, I hope, said sufficient to indicate the main points of my Theory of Cingulum-cusp development. I do not say that there may not be many objections to it, but I think that it is, at any rate, free from serious ones.

The points in its favour may be thus summarized:—

(i.) It harmonizes more fully with what is known of the development of the teeth than either the Tritubercular or Multitubercular theory, the Primary cone representing the Reptilian cone and being always present.

(ii.) It is quite possible and easy thus to homologize the cusps of all teeth, except perhaps those derivative of the Multituberculate type.

(iii.) It is in accordance with Palæontological history.

(iv.) No supposed rotation of cusps is required to have taken place.

It is probable that in time, with greater knowledge and experience, many of the points of detail will have to be modified; indeed, I wish now only to give an outline of this hypothesis in order that it may be more generally tested. Great difficulty has been found in endeavouring to write a lucid explanation of this view, owing to the impossibility of homologizing the cusps under the old terminology.

In conclusion, I most gratefully express my thanks to Prof. G. B. Howes, not only for having suggested this subject for investigation, but also for having enabled me to carry it out in the Laboratory under his charge and for much kind advice and criticism. I would also express my thanks to Mr. G. L. Parsons, of the Westminster Medical School, for having made the drawings necessary for illustration of this paper.

Bibliography.

1. Bateson, W. — Materials for the Study of Variation. London, 1894.
2. Cope, E. D.—"On the Mechanical Origin of the Sectorial Teeth of the Carnivora." Proc. Amer. Assoc. Adv. Sci. vol. xxxvi. p. 254.
3. Cuvier, G.—Ossemens Fossiles. Paris, 1837.
4. Flower, W. H., and Lydekker, R.—Mammals, living and extinct. London, 1891.
5. Goodrich, E. S.—"On the Fossil Mammalia of the Stonefield Slate." Quart. Journ. Micros. Sci. vol. xxxv. p. 407.
6. Hoffmann.—"Ueber die Entwicklung des Kronencementes an den Backenzähnen der Wiederkäuer mit Berücksichtigung der Zahnentwicklung in Allgemeinen." Zeitschr. für wiss. Zool., Bd. lviii. 1894, pp. 566–617.
7. Huxley, T. H.—"On the Cranial and Dental Characters of the Canidæ." Proc. Zool. Soc. Lond. 1880, p. 238.
8. Kükenthal, W.—"Entwickelungsgeschichtliche Untersuchungen am Pinnipedic rgebisse." Jen. Zeitschr. f. Naturw., Bd. xxviii. 1893–94, p. 76.
9. Kükenthal, W.—"Das Gebiss von *Didelphys*." Anat. Anz., Bd. vi. pp. 658–666.
10. Leche, W.—"Studien über die Entwicklung des Zahnsystems bei den Säugethieren." Morphol. Jahrb., Bd. xix. p. 502; and Bd. xx. p. 113.
11. Major, Forsyth.—"On some Miocene Squirrels, with remarks on the Dentition and Classification of the Sciurinæ." Proc. Zool. Soc. Lond. 1893, p. 179.
12. Nawroth.—Zur Ontogenese der Schweinemolaren. Inaugural-Dissertation. Berlin, 1893.
13. Osborn, H. F.—"Recent Researches upon the Succession of the Teeth in Mammals." American Naturalist, vol. xxvii. 1893, p. 493.
14. Osborn, H. F.—"On the Structure and Classification of the Mesozoic Mammalia." Journ. Acad. Nat. Sci. Philad. vol. ix. p. 186.
15. Osborn, H. F.—"The History of the Cusps of the Human Molar Teeth." Address before the New York Inst. of Stomatology, April 1895. Reprinted in Journ. of Brit. Dental Assoc. vol. xvi. pp. 625–635.

16. Osborn and Wortman.—"Fossil Mammalia of the Wahsatch and Wind River Beds." Bulletin of Amer. Mus. Nat. Hist. vol. iv. 1892.
17. Osborn and Wortman.—"Perissodactyls of the Lower Miocene White River Beds." Bulletin of Amer. Mus. Nat. Hist. vol. vii. pp. 343–375.
18. Owen, R.—"Monograph of the Fossil Mammalia of the Mesozoic formations." Monogr. Palæontogr. Soc. vol. xxiv.
19. Parker, W. N.—"On some points in the Anatomy of the Indian Tapir." Proc. Zool. Soc. Lond. 1882, p. 768.
20. Röse.—"Ueber die Entwicklung der Zähne des Menschen." Archiv. mikr. Anat., Bd. xxxviii. 1891, p. 447.
21. Röse.—"Ueber die Entstehung und Formabänderungen der menschlichen Molaren." Anat. Anz., Bd. vii. 1892, p. 392.
22. Röse.—"Ueber die Zahnentwickelung der Beutelthiere." Anat. Anz., Bd. vii. 1892, p. 693.
23. Scott, W. B.—"The Evolution of the Premolar Teeth in the Mammalia." Proc. Acad. Nat. Sci. Philad. 1892, p. 405.
24. Scott, W. B.—"Mammals of the Deep River Beds." Trans. Amer. Philos. Soc. vol. xviii. p.
25. Taeker, J.—Zur Kenntniss der Odontogenese bei Ungulaten. Inaugural-Dissertation. Dorpat, 1892.
26. Thomas, Oldfield.—"On the Homologies and Succession of the Teeth in the Dasyuridæ." Phil. Trans. vol. clxxviii. 1887, p. 443.
27. Tims, H. W. M.—"Notes on the Dentition of the Dog." Anat. Anz., Bd. xi. 1896, pp. 537–546.
28. Winge, O.—"Om Pattedyrenes Tandskifte, især med Hensyn til Tændernes Former." Vidensk. Meddel. fra den naturh. Foren. i Kjöbenhavn, 1882, pp. 1–52.
29. Woodward, M. F.—"On the Development of the Teeth of certain Insectivora." Report of the Brit. Assoc. Adv. Sci. 1895, p. 736.
30. Woodward, M. F.—"On the Development of the Teeth of the Macropodidæ." Proc. Zool. Soc. Lond. 1893, p. 450.

The Problem of Utility: Are Specific Characters always or generally Useful? By Alfred R. Wallace, LL.D., F.R.S., F.L.S.

[Read 18th June, 1896.]

The above stated question is discussed at great length in the second part of the late Mr. Romanes' work on 'Darwin and After Darwin,' fully half of the volume being devoted to it; and in the preface the author states his belief that his arguments are so conclusive that he has "broken to fragments" the doctrine of utility, and that he has "made a full end thereof." A careful perusal of the volume, and a full consideration of all the facts and arguments adduced therein, seem to me to leave the problem just where it was before; but the variety of the subjects discussed, the great mass of details referred to, and the ingenuity of some of the arguments in support of the author's view, lead me to think that I have not hitherto set forth the facts and arguments in favour of the utility-theory with sufficient completeness, while I am indebted to the lamented author for pointing out one or two weak points in my discussion of the question, and for a number of useful references to Darwin's statements on the points at issue, some of which I had overlooked. Although Mr. Romanes' discussion of the question is so lengthy, the problem itself is in its essence a comparatively simple one, and is I believe capable of being solved by a reference to well-known facts and admitted principles. The reason why Mr. Romanes is able to support his views by so many quotations from Darwin's works, is due to the fact that Darwin was firmly convinced of the heredity of acquired characters, and especially of the influence of food and climate and the effects of use and disuse; and this belief must be borne in mind whenever he speaks of specific characters being due to other causes than natural selection. It must also be remembered that Darwin was not acquainted with the evidence we now possess as to the extreme frequency of variation everywhere in nature, its large amount, and its universality in every organ and every character that can be measured or otherwise estimated. Had he known what we now know on this subject, he would not so frequently have made the proviso—"if they vary, for without variation natural selection can do nothing," or have alluded to the possibility of variations of the same kind occurring "perhaps after a long interval of

time." We now know that variations of almost every conceivable kind occur, in all the more abundant species, in every generation, and that the material for natural selection to work upon is never wanting. Accepting, then, these facts of variation, and always keeping in mind the severity of the struggle for existence, nine tenths at least of the progeny of the higher animals perishing annually before reaching maturity, thus leading to a systematic and continual weeding out of the less fit—let us endeavour to realize the process of the formation of new species and the nature of the characters which distinguish allied species from each other.

In my article on "Mimicry and other Protective Resemblances among Animals," first published in 1867, I laid down the principle of utility, perhaps a little too absolutely, in the following passage:—"Perhaps no principle has ever been announced so fertile in results as that which Mr. Darwin so earnestly impresses upon us, and which is indeed a necessary deduction from the theory of Natural Selection, namely—that none of the definite facts of organic nature, no special organ, no characteristic form or marking, no peculiarities of instinct or of habit, no relations between species or between groups of species, can exist but which must now be or once have been *useful* to the individuals or races which possess them." Professor Huxley, in his obituary notice of Darwin, expressed the same idea as follows:—"Every variety which is selected into a species is favoured and preserved in consequence of being, in some one or more respects, better adapted to its surroundings than its rivals. . . . For, as has been pointed out, it is a necessary consequence of the theory of Selection that every species must have some one or more structural or functional peculiarities, in virtue of the advantage conferred by which it has fought through the crowd of its competitors and achieved a certain duration. In this sense it is true that every species has been 'originated by selection.'" Now these characters, in virtue of which the variety has become a species, are in fact its "specific characters," and they alone will absolutely differentiate it from all other species. We need not trouble ourselves about the cases of doubtful species, in which the distinctive characters are either so minute or so unstable that we cannot invariably determine them. On the theory of evolution by natural selection there must be such cases. They are species in the making and not

quite completed. But in the great majority of species definite characters do exist by which any single individual can be recognized and the species to which it belongs be determined; and the question is, whether or no the characters, or combination of characters, which thus differentiate it are now useful or were useful at the time of its origination*. In order to answer this question, we must briefly summarize both the facts and the admitted principles or theories which bear upon it.

Every extensive area contains a number of large and dominant species which appear to be, and probably are for considerable periods, stable, both in average population and in the extent of the area they occupy. Taking any one of these species—say of bird or mammal—so long as the whole conditions of its environment remain unchanged or very little changed it will, theoretically, continue to maintain itself, as we know many species have maintained themselves during the whole period since the glacial epoch, and some very much longer. The species, however, is not absolutely homogeneous. It varies in every generation, not minutely or infinitesimally as was formerly supposed, but very considerably, the variations being easily seen and measured by any one who looks for them; and they extend, so far as we know, to every part of the organism, external and internal, since no part has yet been found to be invariable when a large number of individuals have been compared. The species is therefore composed of a fluctuating mass of variable units which yet maintain the same general average of characters, and this it can only do by a constant or intermittent weeding out of the extremes in every direction. Such a weeding out on a large scale takes place annually, because, although the annual increase by birth is very large, the population of adults remains approximately fixed. The species is maintained in harmony with its environment by the survival of the fittest.

But now let some important change occur, either in climate, in abundance of food, or by the irruption of some new and hitherto unknown enemies, a change which at first injuriously

* To this should be added—"or were correlated with some useful characters." I have referred to such correlations in my 'Natural Selection and Tropical Nature,' pp. 172 and 175; and as to apparently useless characters being in some cases correlated with those which are useful, in my 'Darwinism,' p. 140; but it is cumbersome to restate this part of the theory whenever it is stated that all specific characters are useful.

affects the species. It must, therefore, undergo some amount of modification, either structural or functional, in order to succeed under the new conditions; and the constant variations of every part around its mean furnish the materials for adapting the organism to these new conditions. If a new enemy is the danger to be guarded against, this adaptation may be effected in several ways. Swiftness in running or flying, habits of concealment, or seeking new kinds of food in places inacessible to the enemy, may each lead to the survival of those individuals which were sufficiently intelligent to adopt them or sufficiently favoured by rapid variation in the desired direction. Survival of the fittest in these respects, going on year by year, might lead to the formation of two or more diverging races each able to maintain itself in the presence of the new enemy, while the former average type of the species rapidly became extinct. We should thus have two or three incipient new species; but they would not become well differentiated species till they had acquired certain definite and inportant characteristics. These are (1) some amount of infertility when crossed with the parent form or with each other; and (2) some distinct and conspicuous external characters by means of which the new varieties could readily distinguish their own kind even when at considerable distances or when partially concealed; or, in the case of flowering plants, be distinguished by the insects which fertilize them.

The greatest danger to a species under new and adverse conditions is, that it should not be able to adapt itself to them with sufficient rapidity. It is for this reason that, as Darwin concludes, new species arise, mainly, from those which have a large population, which occupy a wide area, and which present much variation—a combination rarely found except in continental areas. But this danger is evidently much increased if crossing with the parent form is not at first checked and soon afterwards completely prevented, except as a quite exceptional occurrence. The means of preventing this intercrossing are, for animals, either infertility, external distinctions leading to the preferential mating of similar forms, or physical isolation. The latter I believe, with Darwin, to be of comparatively little importance and to have very rarely been the chief agent in modification. In the great majority of cases a new species must arise amidst the population of an existing species; and while its adaptation is progressing any intercrossing with the parent form will be

injurious. I have endeavoured to show, and can still find no flaw in my reasoning, that mutual infertility would be usually brought about by natural selection wherever the two forms were in contact, and also that the early occurrence of well-marked external differences would assist greatly in the rapidity of adaptation *. This view will explain the curious fact of the well-marked differences of colour or form which almost invariably characterize allied species. These "recognition marks," as I have termed them, are of great use even to existing well-defined species, but they must have been of still greater use during the earlier stages of differentiation, when the very existence of the new form must have largely depended on them.

I may here remark that it is because these external differences of colour or marking are quite as constantly present in peculiar insular species as in those inhabiting a continent, that I do not believe in local isolation as of any importance in species-formation. Insular species may have been produced in two ways. Either a portion of a declining species may have reached the island, where it survived through the more favourable conditions while it became extinct on the continent; or, a few individuals of a dominant species reached the island, where, owing to the absence of competition, they rapidly increased till the island became fully stocked with the unchanged species. Then (and then only) survival of the fittest would begin to act, and the differences of food and climate, with the different kinds of enemies, would render some modifications of structure, form, or colour advantageous, and thus a new species would be formed by adaptation from the old one in almost exactly the same way as on the continent. In both these cases recognition-characters, to aid in the prevention of intercrossing, would be produced by natural selection. But if insular species have usually been formed by a few individuals somewhat different from the type having first reached the island and thereafter preserved their peculiarities, there is no reason why any distinctive and stable form of coloration or marking should have been developed, since there would be no similar species from which it would need to be differentiated. Neither is the small amount of divergence that usually prevails between the mean of a few individuals taken at random, such as might have accidentally reached an island, and the average type

* 'Darwinism,' pp. 174-180.

of the species, at all comparable with the well-marked characters that usually distinguish insular forms, and there is nothing in mere isolation without selection which can increase the difference. As examples we may refer to the many peculiar species of butterflies and birds found in the various islands of the West Indian and Malayan Archipelagoes, which are quite as distinct from each other as are allied continental species, and which exhibit all the characteristics of forms which have been fully differentiated by natural selection.

The sketch now given of the usual mode of formation of new species under natural selection leads to the conclusion that every species (of the higher animals at all events) will usually possess at least three peculiarities: in the first place, it must exhibit some difference of structure or function adapting it to new conditions; secondly, some distinction of colour, form, or peculiar ornament serving as distinctive recognition marks; and, thirdly, the physiological peculiarity of some amount of infertility when crossed with allied species. The first two constitute its "specific characters." But if we consider that every species in the long line of its ancestry must have had similar specific characters, adapting it to the peculiar conditions of its environment and distinguishing it from its nearest allies; that some of these characters, when generally useful, have persisted, and now constitute generic or family characters; that others have been again and again modified so as to adapt them to new and sometimes quite different conditions; and that others again, becoming useless, persist when quite harmless or remain in a more or less rudimentary condition; and when we further consider that many genera and families extend far back into geological time and must have originated in the midst of a physical and biological environment very different from that which now prevails, we shall dimly understand how complex are the forces and processes which have led to the assemblage of characters now presented by each organism, and how difficult it must be to determine positively that any one of these characters is not, *nor ever has been*, useful to its possessor. Yet this is what is done by those writers who maintain, as did the late Mr. Romanes, that the majority of specific characters are not and never have been useful, but have arisen through definite variation under the influence of definite causes, and, when neither useful nor hurtful, persist and constitute the main external differences which we observe between

species and species. This theory, which, although to some extent held by Darwin himself, I consider to be wholly erroneous, we will now proceed to discuss.

It may be well first to dispose of a point, made much of by Mr. Romanes, that I do not urge utility as a characteristic either of varieties or of genera and higher groups, and that it is therefore illogical to claim it for species. But this is a misapprehension, since I *do* claim that when varieties are constant, are hereditary, and occupy a definite area, and are therefore what Darwin termed "incipient species," the characteristics which distinguish them from the parent species are, to some extent, adaptive and useful, and will become fully so when the variety becomes a fully differentiated species. And as to genera and families, it is obvious that every one of their distinguishing characters was once a specific character, since genera are merely groups of species, all of which were derived from one parent species, and which have become more or less isolated by the extinction of intermediate forms. Families are, in the same way, derived from a single genus and ultimately from a single species, and the same reasoning applies to them. The reason why my argument on this question has been limited to species is, because the whole problem is included in that of species: it is in them that the process and laws of development can be best studied free from many of those complexities of modification and survival of disused and partially aborted parts and organs which often constitute generic or family characters. If every one of the new characters or new combinations of characters which arise when a new species becomes differentiated from its parent-form,—if every one of these is adaptive and utilitarian, then no higher groups can possess characters other than those which were once adaptive, since genera and families can never acquire new characters except through every one of their component species acquiring those characters. The problem as exhibited in species includes therefore the problem in all higher groups.

I have already set forth in some detail the argument for utility founded on the fact of the continuous progress of the discovery of utilities with the continuous growth of our knowledge of the life-histories and inter-relations of plants and animals *. I will therefore now devote more special attention to the fundamental argument, that whereas every modification of a species which

* 'Darwinism,' pp. 131–142.

arises under the influence of natural selection must, from the very nature of its origin, be useful to the new form, no other agency has been shown to exist capable of producing non-utilitarian characters *in every individual constituting a species, neither more nor less.* Now the general cause which is adduced as being able to do this is stated by Darwin in the following passages, which are quoted by Mr. Romanes as expressing his own views :—

"There must be some efficient cause for each slight individual difference, as well as for more strongly marked variations which occasionally arise; and if the unknown cause were to act persistently, it is almost certain that *all* the individuals of the species would be similarly modified" ('Origin of Species,' p. 171).

Again, after referring to cleistogamic flowers and degraded parasitic animals, he says :—

"We are ignorant of the exciting cause of the above specified modifications; but if the unknown cause were to act almost uniformly for a length of time, we may infer that the result would be almost uniform; and in this case all the individuals of the species would be modified in the same manner" ('Origin,' p. 175)*.

Now these passages, merely as stating a possibility or a probability, appear to me to be wanting both as regards logic and in the absence of any appeal to the actual facts of variation. For the argument is, briefly, that the same causes will always produce the same or closely similar results. But this is only true when the same causes *act upon identical materials and under identical conditions.* But the very foundation of the Darwinian theory is, that the materials—the individuals of a species—are *not* identical, but that they vary indefinitely and in many directions even under closely similar conditions. How then can any external or internal causes produce an identical result—a definite new variation—in *all* the individuals of a species, born as they are of varying parents, of different ages, and subject to ever fluctuating conditions? It seems to me, therefore, that the *à priori* probabilities are all against Darwin's supposition.

Now let us see how far the *facts* of variation give any support to the theory of useless specific characters. If there is one thing better established than another it is that the individual variations which are constantly occurring in all common species

* In my 'Darwinism,' p. 141, I have stated my opinion that Darwin did not believe in the production of useless characters in *all* the individuals of a species. I had overlooked the passages quoted by Mr. Romanes and given above, which certainly show that he did believe it.

are indefinite in their character and very unequal in their amount. Some species are much more variable than others, and Darwin has shown reasons for believing that any change of conditions induces *variability*, but not that it causes definite *variations*. The two things are radically distinct. So far as I am aware, no evidence has been adduced of any special conditions which have produced a definite variation in the whole offspring of all the individuals subjected to it. But it must do more than this. For it must produce a variation so exceptionally stable that it constantly recurs in all the offspring of successive generations, even though those offspring are subjected to considerable change of conditions, as are the individuals of all species except the rarest or the most local. Only with such constancy and stability of inheritance could a useless character become fixed in every individual of a species, which it must be to be a "specific" character. It must, therefore, from the very first have been invariable. But this feature of invariability without selection has not been found to characterize any variation, whether occurring among wild or domesticated organisms. Such an occurrence would necessarily have forced itself upon the attention of breeders and horticulturists. For if the theory is true that the majority of specific characters are of this useless kind, their occurrence as permanent and unchangeable variations must be a common phenomenon, and we ought to find that foreign plants when first cultivated very often present new characters, not sporadically but appearing in every individual, and which cannot be got rid of, since they do not vary and selection would therefore be powerless to eliminate them. Has any indication of a phenomenon of this kind ever been noted?

Let us come now to the actual causes said to produce useless specific characters. According to Mr. Romanes they are five in number: Climate, Food, Sexual Selection, Isolation, and Laws of Growth. Let us consider how these are known to act or are alleged to act. Climate and Food undoubtedly produce modification in the individual, but it has not yet been proved that these modifications are hereditary. If this could be proved the whole discussion on the heredity of acquired characters would be settled in the affirmative. The supposed proof that these causes produce definite changes which are hereditary is derived from the fact that there is often a simultaneous change in the colours of many animals, or in the form or texture of the foliage of many plants, in different parts of the area they occupy which are characterized

by differences of climate. But in every case these changes can be interpreted as adaptations for protection in the case of the animals, and as either adaptations or individual non-hereditary modifications in the case of the plants. The firm belief that such individual characters were usually, if not always, inherited led to some looseness in Darwin's reasoning on this point, and still more so in that of most modern upholders of the theory.

The next alleged cause, Sexual Selection, whether we limit it, as I do, to the struggles of the males, leading to the development of weapons and defensive armour, or with Darwin extend it to the choice by the females of the more ornamental males, thus leading to the development of decorative plumes &c., is really a form of natural selection, and sexual characters are therefore useful characters. It is true that, from my point of view, male distinctive colour and ornament have not this particular use; and Mr. Romanes makes a good point against me when he says that in imputing their origin and development to the surplus vitality and energy of the male I give away my case, since I admit that useless specific characters may be developed independently of natural selection. This is owing to my having omitted to lay special stress on the *specific* part of each ornament being really a "recognition mark," and therefore essential both to the first production and subsequent well-being of every species. In the summary of my argument ('Darwinism,' p. 298) I have adduced the need of recognition as the cause of specific specialization of colour, but in the body of my discussion as to sexual ornaments I have not referred to it, and this omission greatly weakens my argument. I should have said that the accessory plumes and other ornaments *originate* at points of great nervous and muscular excitation, and are *developed* through surplus energy; and that, from their first appearance, they were *utilized* for purposes of recognition, which explains both their comparative stability in each species and their distinctness in allied forms*.

* Since writing this paper I have carefully studied Professor Weismann's new theory of "Germinal Selection," which seems to me to have a high degree of probability, and which, if true, enables us to explain two phenomena which have not hitherto been fully explicable. These are (1) the complete or almost complete disappearance of many characters which have become useless; and (2) the development of secondary sexual characters far beyond the point of utility as recognition marks, and, apparently, up to the extreme point of incipient hurtfulness. It thus furnishes the one link necessary in the chain of argument proving that these secondary sexual characters are explicable without calling in the very problematical agency of female choice.

The next alleged cause, Isolation, I do not admit to be a *vera causa* at all, for reasons already given. It is, at most, an aid to the differentiation of new species by natural selection.

The last alleged cause, the Laws of Growth, can never, of itself, account for specific characters, but only for those structural and histological peculiarities of organisms which characterize the higher groups such as classes and sometimes perhaps orders and families; and even these must always, when they first originated, have had a utilitarian character, since it is almost impossible to conceive that the details of structure of the various tissues or organs produced under the action of these laws were absolutely indifferent to the well-being of the organism.

If, then, we admit, as I do admit, that certain growths, appendages, or markings, which are of no use to the organism, do occasionally appear, no agency has been adduced which could, first, cause these useless characters to appear in every individual of a species, and then totally cease to appear whenever any portion of this species is selected and slightly modified so as to occupy a new place in nature or to save itself from extinction by some new enemy. Whenever useless characters are said to be "specific," it seems to be forgotten that one species has always passed continuously into another by a process of normal individual variation and survival of the fittest. There is no chasm in such a process, no sudden transition from one creature to another of a different nature. The transition is by a purely normal and almost imperceptible process of adaptation to new conditions, and in itself furnishes no reason whatever why any useless character, if it had constantly reappeared in the countless millions of individuals during all the millions of generations of the duration of the species, should at once disappear, or be replaced by some new character equally universal, equally invariable, and equally useless.

I strongly urge, therefore, that the general causes suggested by Darwin as possibly leading to the production of useless specific characters, as well as the more special causes enumerated by Mr. Romanes, do not apply to the actual facts of variation and heredity so far as they are yet known to us; and further, that no attempt has been made to show, even hypothetically, how, through the action of known causes, such characters, when they do arise, can become first extended to every individual of a species, and then be totally obliterated as regards any portion of the species which may become modified so as to constitute a new

species. Useful characters thus strictly limited are the necessary and logical results of modification through survival of the fittest. No agency has been shown to exist capable of producing useless characters similarly limited. And as it is beyond the powers of human reason to know absolutely that any characters so limited as to be really specific are and always have been useless, it is both unscientific and illogical to postulate such characters as being present in all or many species, and therefore as constituting an essential characteristic feature of specific forms.

The preceding discussion may, I hope, be considered sufficient to show that useless specific characters, if they exist, can only be the result of some comparatively rare and exceptional conditions, and that they certainly are not, as has been alleged, a general characteristic of species; but it may be as well to notice a few of the special cases which have been adduced by Mr. Romanes and others as examples of their existence or as illustrating their formation.

The Niata cattle of South America, which have strangely upturned jaws, are said to breed very true and to form a definite well-marked race which, if the character were not injurious but simply indifferent, might lead to the formation of a species defined by this useless specific character. The short-legged Ancon sheep, and the six-toed cats, are other examples of such remarkable abnormalities or sports which have the curious property of being strongly hereditary, and yet, apparently, of never leading to the formation of new species. Almost all students of evolution now admit that "sports" or large and sudden divergencies from the specific type are *not* the materials from which new species have been formed, the reason being that they are extremely rare occurrences; and when any such "sport" appeared in a species, the individual presenting it would either be avoided by its fellows and leave no offspring, or by repeated crossings with the normal type the sport would disappear. We may, no doubt, imagine conditions under which a sport of this kind, once appearing in both sexes, might lead to the formation of a breed and ultimately of a species; but the combination of conditions requisite to bring this about is so improbable that we can only look upon it as a bare possibility. But the question we are discussing is not whether, under certain very rare and exceptional conditions, a few species may possibly be formed which are distinguished only by altogether useless

majority of species and, to use Mr. Romanes' words, exist in "enormous numbers." The case of abnormal sports or monstrosities such as those here referred to can certainly not be adduced as giving any support to this view.

The next case, that of the Porto Santo rabbits, is held by Mr. Romanes to prove that the constant characters which distinguished them from common rabbits were only results of the action of peculiar conditions on individuals, and were not produced by natural selection. He arrives at this conclusion from the fact that one of the two which died at the Zoological Gardens after four years' captivity was sent to Darwin, who found that the special colouring that distinguished the breed—the absence of black on the tail and ear-tips and the reddish colour on the back—had almost disappeared, and that the whole colouring was very little different from that of the common wild rabbit. Hence Mr. Romanes concludes that other wild species may be really only climatal forms, and their peculiar characters be non-adaptive. But no mention is made of the remarkably small size of these rabbits, which were only about half the weight of the common wild species and which looked no larger than average rats. If this also were a result of the action on the individuals of scanty food or a peculiar climate, it would have rapidly disappeared with ample food at the Zoological Gardens; and neither in this point nor in the peculiar form of the posterior end of the skull and interparietal bone, which was so distinct that Darwin figured it (see 'Animals and Plants under Domestication,' i. p. 118), did he note any difference in the dead animal. It seems probable, therefore, that the colour-peculiarities of the Porto Santo rabbits were due to a change of tint of the longer hairs which may have been lost during the illness which led to the animal's death. And as we have no information as to the supposed change having been progressive during the four years of confinement, or that it affected the second specimen, no such conclusion as that drawn by Mr. Romanes can be held to be established.

The only other case of much importance is that of changes of colour said to be directly caused by changes of climate, and especially by darkness in cave-animals. In this latter case it is declared by Mr. Romanes that the loss of colour cannot be of any use and cannot have been caused by natural selection. It is, therefore, an example of a useless character occurring in all the individuals of many unconnected species. In the case of the

Proteus, however, it is stated that when subjected to the action of light in confinement, the skin becomes dark, showing that the character is in some degree an individual one, due probably to deficiency of nutrition or, partially, to the need of light for the secretion of the pigment. The whiteness is here not a specific character. And if, in other cases, it is permanent and specific, it may have had a very obvious use in the early stages of the modification of a cave-fauna. For if any animals were isolated in caverns which were not totally dark, the light tints would be important as recognition marks, enabling the sexes to find each other; and when, at a later period, the species spread into the parts which were totally dark, there would be no cause leading to a return of the positive colour, especially as all cave-animals subjected to total darkness must at first have been in great danger of extinction from deficiency of food, and there would thus be no surplus nourishment available for the production of pigments.

Several biological friends with whom I have discussed this question, while agreeing that the majority of specific characters are useful, have suggested that useless characters may have been produced in some such manner as the following. If some useless character appears as a variation in some individuals of exceptional vigour, it may increase by interbreeding, and its repeated production being perhaps favoured by some local conditions, it may come to form a marked local variety. Now, if the conditions become unfavourable to the species in the area occupied by the type, this may in course of time become extinct, and the variety distinguished by the altogether useless character will remain as the only representative of the species. It may be admitted that such a mode of origin of a non-utilitarian specific character is conceivable, but whether it ever actually occurs in nature may be doubted; while if it does occur, it must be owing to so rare a combination of circumstances that it can produce no such general prevalence of useless specific characters as is claimed by the advocates of that theory *.

In order to ascertain whether the immediate antecedent to such a mode of species-formation as is suggested is at all common, and thinking that British flowering plants offer the best materials for its detection, I put the case to two experienced British

* If, however, the variation is preserved because it occurs in exceptionally vigorous individuals, it is correlated with a character which is useful.

botanists as follows:—Are there any examples within your knowledge of well-marked varieties (not mere individual states due to local conditions) which occupy a considerable area to the exclusion of the parent species, and which do not occupy any area, or only a very small one, with the type? Each of them suggested several species which seemed to answer to the conditions, but on further consideration it appeared that they did not do so, and we were finally reduced to a single case, that of one of the species of *Rubus*, a genus which most botanists will regard as a very unsafe one to draw any conclusions from. *Rubus radula*, Weihe, is said to be abundant in the Midland parts of England, but in the Southern and South-western counties to be replaced by the variety *anglicanus* of W. M. Rogers, the type never having been found in the area occupied by this variety. If this is the case, and the two forms, said to be easily recognizable, really occupy distinct areas and nowhere overlap, or very slightly so, then we have the condition precedent to the formation of a species by the extinction of the type, thus leaving the variety to represent the species. Of course in this case we do not know that the characters which distinguish the variety are useless; but if they are so, and if the variety should possess some superior vigour of constitution or other useful peculiarity which enables it to survive when the type dies out, we should have an illustration of one mode in which useless specific characters may possibly have arisen.

The enquiry is interesting, however, because it brings to light the rather unexpected fact, that fixed varieties of plants occupying considerable areas to the exclusion of the type are not common, and, perhaps, in our island do not exist. And should they be found to occur more frequently in other countries—as varieties of birds, mammals, and reptiles do occur in separate areas in North America—they may be usually explained as adaptations to very different climatic conditions, in which case the distinguishing characters will be utilitarian, and the local varieties will be really incipient species.

The preceding enquiry leads us to certain very definite conclusions. In the first place, we see that *species*, which have been differentiated as such by the laws of variation and survival of the fittest, must be characterized by certain peculiarities whereby they have obtained an advantage in the struggle with their fellows. These peculiarities constitute their "specific characters,"

and these *must* be useful. As this applies also to every species in the direct line of descent, the characters which are sectional or generic must also, at the time of their origin, have been useful.

In the second place, although non-utilitarian characters do undoubtedly appear in the normal course of variation, no agency has yet been detected adequate to the extension of these useless peculiarities to all the individuals which constitute a species, and, further, to prevent their extension to any of the varieties which are destined to become new species. Unless the power in question can have this twofold effect it cannot lead, except by accident, to the production of useless specific characters.

Under conceivable conditions, however, it is possible that certain useless characteristics may become limited to the individuals of a single species. But what we know of the modes of variation and the distribution of varieties indicates that, if at any time so produced, they must be altogether exceptional and of the nature of chance products; and that they cannot possibly constitute such a general characteristic of species as has been suggested.

Our final conclusion is that, whether we can discover their use or no, there is an overwhelming probability in favour of the statement that every truly *specific* character is or has been useful, or, if not itself useful, is strictly correlated with such a character.

On the Fistulose *Polymorphinæ*, and on the Genus *Ramulina*.

By T. Rupert Jones, F.R.S., and F. Chapman, A.L.S., F.R.M.S.

[Read 16th January, 1896.]

Part I.

The Fistulose Polymorphinæ.

It having been suggested that the several specimens referred to the genus *Ramulina*, Rupert Jones, may possibly belong to fistulose *Polymorphinæ*,* this memoir has been undertaken to show what evidence there is for or against the suggestion.

With this object in view, it is necessary for us to define the special *Polymorphinæ* which bear extraneous growths of fistulose form. Therefore, in the first place, we propose to take a survey of the known fistulose, tubulose, and racemose *Polymorphinæ*.

* F. B. Balkwill and F. W. Millett.—"The Foraminifera of Galway. Journ. Microsc. Nat. Sci., vol. iii. 1884, p. 33.

These admit of being grouped as follow:—

I. *Apical.*—Those which have the exogenous shell-growth confined to the apical or oral extremity of the shell (apical): and of this kind there are five recognizable varieties, namely,—

1. *Single crest.* A simple comb or crest with marginal tubes.
2. *Circular and flat.* A flat circular top with marginal tubes.
3. *Radiate cushion.* Tubes radiating from a cushion-like mass.
4. *Radiate cluster.* Radiate or subradiate cluster of tubes.
5. *Racemose.* An irregular fistulose mass.

II. *Subapical.*—Those in which the fistulose outgrowths are confined to the region just below the apertural apex.

III. *On the general surface.*—Those which have either tubes or irregular fistulose patches scattered on the general surface.

IV. *Marginal.*—Those in which the extra shell-matter is arranged as a thin outstanding flange or wing on the margin.—Most of these last were perhaps parasitic, attached to some object.

V. *Mixed.*—There are many specimens which combine more or less of the foregoing kinds of outgrowths,—thus apical, subapical, on the general surface, and on the sides or the margin; and therefore they cannot stand as specially separate varieties.

I, 1–5.—The first four groups of the *apical* growths seem to keep tolerably separate from the others in being confined to the apical region, and do not occur in the *mixed* forms; but the *racemose* style of outgrowth is variously modified in the general-surface, marginal, and mixed groups.

II. *Subapical growths.*—The examples of the subapical or cervical arrangement of tubules or fistulæ are not common as a distinct group. They consist in one case (39*) of coarse tubes

* These numbers refer to the detailed catalogue at pp. 508–516.

(broken) far apart and irregular. In another (40) two circles of small holes and one broken tube remain in evidence.

Amongst examples in which the style of outgrowth is mixed, one (62) has a single circle of subapical holes (equivalent to lost tubules), but these are associated with scattered and exogenous patches, and sinuous rows of holes disposed over the general surface. The bases of some strong cervical tubes exist in another (60), together with an apical growth. These specimens indicate the existence of the *subapical* kind of growth; but show also that it becomes mixed with other conditions.

III. *Fistulose growths on the general surface; variable in extent.*—The outgrowth in some examples (42) is very redundant and somewhat obscures the form of the initial Polymorphine series. The specimen 43 is a good example of tubular fistulose outgrowths disposed over the general surface and with some apical tubes more limited in extent. In another form (46) the outgrowths have a tendency to become lateral and are more or less flattened. Short thick tubules, not at all confluent at their bases, scattered over all the surface, in 47, characterize apparently a distinct variety.

IV. *Marginal outgrowths.*—The simplest example of marginal growth is 48, showing a double series of perforations along one edge and the base of the shell, whence doubtlessly outgrowth had, as it were, taken root, the sarcode having been extruded through the shell to form calcified processes. The exact condition of this fistulose growth is indeterminable.

A good marginal growth, chiefly at the oral end, on one side, and at the base, in 49, has a somewhat racemose edge; and 58 has a more continuous and more racemose marginal expansion. Still more freely branching is the marginal investment of 53.

A simple marginal wing, nearly flat or merely undulose, belongs to the *attached* form, *Polymorphina concava*, Williamson, 54. A similar form is 56, but the flange shows indications of the septation of the shell being continued in it; and the edge in this instance is more or less dentate.

In the coarsely tubulated marginal outgrowth of 57 (unfortunately broken), we have a somewhat different condition of this kind of growth, less confluent than in others.

In 5 the marginal growth, being only at the oral end of the shell, presents, though it is strongly dentate, an analogy to the crest-like apical growth (" *damæcornis* ") of 4, and is here grouped with it.

V. *Mixed growths.*—A flatly racemose marginal outgrowth is associated with the *apical* in 67; also with the *apical* (broken) in 68; and with both *apical* and *subapical* growths in 69: therefore it cannot be regarded as a peculiar or special condition.

So also the mixed conditions of apical with subapical, or with scattered patches and tubules, cannot be set apart; for the *racemose-apical* falls in with some of the other modifications, as 61, 62, 63, 66—see the list of forms.

The frequent occurrence of apical extrusions, and the probability of the marginal and other superficial exogenous growths having started from the aperture of the apex and stretched downwards (backwards), shows at least that only adult individuals produced them; and probably the perforations left after excrescences have been removed were due to absorption of the intervening shell-wall (as suggested by T. Alcock), so as to allow of direct communication of the inner and outer sarcode *.

We cannot entertain the notion formerly advanced by M. O. Terquem, that any of these outer growths may be due to parasitical Polyzoa allied to *Cellepora* †; for we regard them as a permanent calcareous tubing of the chief pseudopodia.

In none of the foregoing Fistulose *Polymorphinæ* do we find tubes and tubules exactly corresponding with the tubular structures that have been referred to *Ramulina*.

A Polymorphine form figured by Beissel, and much like our "*diffusa*," shows a peculiar structure, such as we find in *Ramulina* ‡. Hence we think it best to take this internal structure,

* T. Alcock.—"On *Polymorphina tubulosa.*" Proc. Lit. Phil. Soc. Manchester, vol. vi. 1867, pp. 85–90.

† O. Terquem.—"Les Foraminifères du Pliocène supérieur de l'Isle de Rhodes." Mém. Soc. Géol. France, sér. 3, vol. i. 1878, no. 3, pp. 1–133.

‡ T. Beissel and E. Holzapfel.—"Die Foraminiferen der Aachener Kreide." Abhandl. Königl. Preuss. geol. Landesanstalt, neue Folge, Heft 3, 1891, p. 59, pl. xii. figs. 9–16.

instead of the outer aspect, as a guide in determining the systematic relationship of this form.

The aulostomate or exogenous growth in the Foraminifera is not confined to the genus *Polymorphina*, as will be seen on referring to the figures of the interesting examples of *Cristellaria crepidula* and *C. calcar* [var.], given by Dr. Goës in his work on the Foraminifera of the Caribbean Sea *. Here we see the terminal growth and stag-horn condition of the aperture well marked; the last chamber having given off tubular sheaths for a few large pseudopodia.

The following is, so far as we are aware, a complete list of the known forms of fistulose *Polymorphinæ*. They are grouped according to their mutual relationships, with reference to their zoological type-forms, and accompanied with concise notes on the characters of the outgrowths. Thus adding to our knowledge of the genus, this (first) part of our paper may be regarded as supplemental to the Monograph of *Polymorphina* by Messrs. Brady, Parker, and Jones, in the Transactions of the Linnean Society, vol. xxvii. 1870 †.

* A. Goës.—"On the Reticularian Rhizopoda of the Caribbean Sea." Kongl. Svenska Vetenskaps-Akad. Handlingar, vol. xix. 1882, no. 4, pp. 43 and 49, pl. iii. figs. 40, 52.

† The history and affinities of this genus are fully treated of in the Monograph referred to; but the critical examination of the Foraminifera depicted in Ehrenberg's 'Mikrogeologie' not having been completed when that Monograph was published in 1870, several inaccuracies were introduced; and certain errors should be corrected according to Parker and Jones's critical determinations given in the 'Annals and Magazine of Natural History,' ser. 4, vol. ix. 1872, pp. 211–230, 280–303; vol. x. 1872, pp. 184–200, 253–271, 453–457.

Thus at page 213 delete *Strophoconus ovum*, *spicula*, and [*Grammostomum*] *laxus*; at p. 219, *Strophoconus stiliger* and *acanthopus*; at p. 220, *Grammostomum turio*; at p. 223, *Strophoconus Hemprichii*; at p. 224, *Sphæroidina Parisiensis*; at p. 227, the 1st, 2nd, 3rd, 5th, 6th, 8th to the 16th, and the 19th of Ehrenberg's species; and add *Loxostomum vorax*, pl. xxviii. fig. 24; at p. 232 delete *Polymorphina asparagus* and *turio*, *Sagrina longirostris*, and *Vaginulina obscura*; at p. 233, *Vaginulina paradoxa*; at p. 234, *Polymorphina nucleus*; at p. 238, *Grammostomum costulatum*; at p. 242 add, under *Globulina tuberculata*, *Proroporus verrucosus*, pl. xxix. fig. 19.

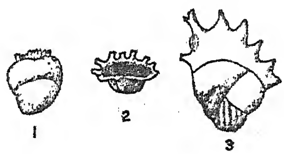
Classification of the Fistulose Polymorphinæ.

SERIES I.—APICAL OUTGROWTHS.
Figs. 1–23.

Group No. 1.—Apical Crests.

[N.B.—*Surface of outgrowth is smooth unless otherwise stated.*]

Proposed varietal *names* *.	*Salient characters of Outgrowths.*	*Nos. in detailed list*, pp. 508–516.
1. Var. *damæcornis*, Reuss. Figs. 1–3.	*a.* Simple crest over apical (oral) part of test.	1, *2*, and 3.
	[Those marked thus *2* are figured here.]	
	b. Crest or comb on the apex, with marginal tubules (unequal); and with inferior flange-like series in one instance.	*4* and *5*.
	c. An irregular crest, terminating in somewhat lengthened tubules.	6.

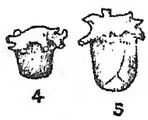


Var. damæcornis, *Reuss*.

Fig. 1. *Polymorphina gibba* (d'Orb.). [*Globulina transversa*, Terquem, 1882.]
„ 2. *P. trigonula* (Reuss). [*Polymorphina* (*Guttulina*) *damæcornis*, Reuss, 1845.]
„ 3. *P. regina*, Brady, Parker, and Jones. [*Polymorphina regina*, fistulose form, Wright, 1886.]

Group No. 2.—Apical Crowns.

2. Var. *coronula*, nov. Figs. 4, 5.	*a.* Flat circular top, with marginal tubules, horizontal and equal.	*7* and *8*.



Var. coronula, nov.

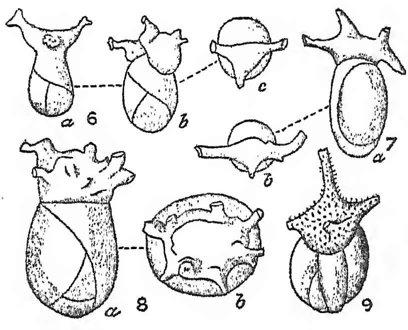
Fig. 4. *P. gibba*, d'Orb. [*Polymorphina damæcornis*, Wright, 1875.]
5. *P. gibba*, d'Orb. Chapman Coll.

* For the application of these varietal names, see further on, p. 516.

Group No. 3.

Apical cushioned Outgrowths.

Proposed varietal *names.*	*Salient characters of Outgrowths.*	*Nos. in detailed list*, pp. 508–516.
3. Var. *acuplacenta*, nov. Figs. 6–9.	*a.* A more or less distinctly cushioned and sessile mass, giving off radial tubules.	9, 10, 11, *12*, and *13*.
	b. Similar, with the test and outgrowth prickly.	*14*.
	c. Similar, with the surface of only the outgrowth prickly.	15.



Var. acuplacenta, nov.

Figs. 6 *a*, *b*, *c*. *P. gibba*, d'Orb. *a* and *b*, lateral aspects; *c*, oral aspect. [*Globulina gibba*, Terquem, 1878.]

„ 7 *a*, *b*. *P. gibba*, d'Orb. *a*, lateral aspect; *b*, oral aspect. [*Guttulina gravida*, Terquem, 1878.]

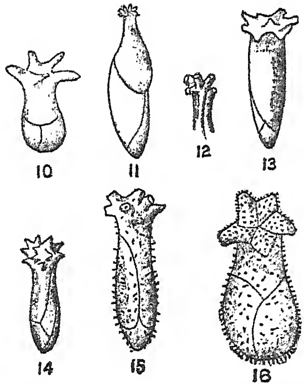
„ 8 *a*, *b*. *P. gutta*, d'Orb. *a*, lateral aspect; *b*, oral aspect. [*Polymorphina Roemeri*, Reuss (*P. diluta*, Bornemann), 1870.]

„ 9. *P. communis*, d'Orb. [*Polymorphina lactea* (fistulose form), Brady, 1884.]

Group No. 4.

Apical Cluster of Tubes.

4. Var. *horrida*, Reuss. Figs. 10–16.	*a.* Low radiate cluster of tubules.	16, *17*, 18, *19*, 20, *21*, 22, and 23.
	b. Irregular subradiate cluster of tubules.	*24*.
	c. Similar, with surfaces of test and outgrowth prickly.	*25* and *26*.

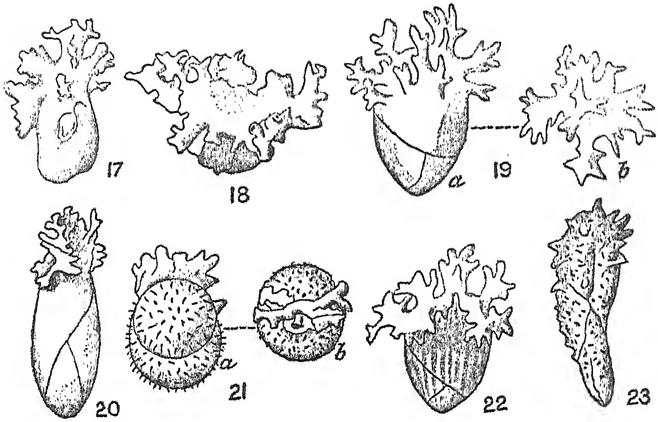


Var. HORRIDA, *Reuss.*

Fig. 10. *P. gutta,* d'Orbigny. [*Globulina horrida,* Reuss, 1845.]
,, 11, 12. *P. fusiformis,* Roemer. Fig. 12=fistulose extremity more highly magnified. [*Polymorphina lanceolata,* Reuss, 1870.]
,, 13. *P. fusiformis,* Roemer. [*Polymorphina prisca,* Berthelin, 1880.]
,, 14. *P. fusiformis,* Roemer. [*Polymorphina horrida,* Wright, 1875.]
,, 15. *P. fusiformis,* Roemer. (A hirsute subvariety.) [*Polymorphina fusiformis,* fistulose var., Chapman, 1896.]
,, 16. *P. hirsuta,* d'Orbigny. [*Globulina horrida,* Reuss, 1850.]

GROUP NO. 5.—APICAL RACEMES.

Proposed varietal *name.*	*Salient characters of Outgrowths.*	*Nos. in detailed list*, pp. 508–516.
5. Var. *racemosa,* nov. Figs. 17–23.	*a.* Group of separate tubules slightly branching (broken) around apex.	27.
	b. Branching (racemose) group, sessile; not cushioned.	*28, 29,* 30, *31.*
	c. Rough mass with short irregular tubules,—low racemose.	*32.*
	d. Low racemose tubules, smooth, but with prickly initial series.	*33.*
	Regularly racemose outgrowth, with initial test finely striate.	*34.*
	Fistulæ scattered over apical region ...	*35.*



Var. RACEMOSA, nov.

Fig. 17. *P. gibba*, d'Orbigny. [*Polymorphina tubulosa*, Jones, Parker, and Brady, 1866.]

„ 18. *P. gibba*, d'Orbigny. [*Polymorphina tubulosa*, Jones, Parker, and Brady, 1866.]

„ 19 *a*, *b*. Near *P. lactea* (Walker and Jacob). *a*, lateral aspect; *b*, oral aspect. [*Globulina oviformis*, Searles Wood, MS., about 1846.]

„ 20. *P. lactea* (Walker and Jacob). [*Polymorphina prælonga*, Terquem, 1878.]

„ 21 *a*, *b*. *P. hirsuta*, Reuss. *a*, lateral aspect; *b*, oral aspect. [*Polymorphina hirsuta*, Reuss, 1870.]

„ 22. *P. virgata* (Searles Wood, MS.) [*Globulina virgata*, Searles Wood, MS., about 1846.]

„ 23. *P. fusiformis*, Roemer.

FRAGMENTS OF APICAL OUTGROWTHS.

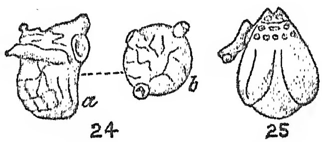
	Salient characters of Outgrowths.	*Nos. in detailed list*, pp. 508–516.
*a**.	Fragment of smooth bifid tubule, branching at the ends.	36.
*b**.	Fragment of smooth bifid tubule	37.

SERIES II.

Group No. 6.—Subapical Outgrowths.

Figs. 24, 25.

Proposed varietal *names.*	*Salient characters of Outgrowths.*	*Nos. in detailed list*, pp. 508–516.
Var. *circularis*, nov. Figs. 24, 25.	*a.* Tubules apart	38 and *39*.
	b. Tubules in two circles	*40*.



Var. circularis, nov.

Fig. 24 *a*, *b*. Near *P. gibba*, d'Orbigny. With wrinked surface. ["Testa incertæ sedis," Terquem, 1878.] *a*, lateral aspect; *b*, oral aspect.

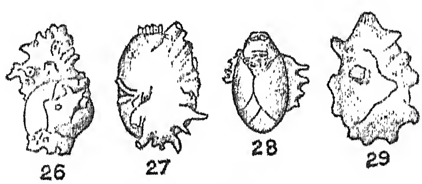
„ 25. *P. problema*, d'Orbigny. [*Guttulina racemosa*, Terquem, 1878.]

SERIES III.

Group No. 7.—Outgrowths on the General Surface.

Figs. 26–29.

Var. *diffusa*, nov. Figs. 26–29.	*a.* Irregular tubules, lumpy and short.	41 and *42*.
	b. Short irregular tubules, of various sizes, some broken.	*43*.
	c. Irregular patches..........................	44, 45, and *46*.
	d. Short fistulæ, regularly scattered	*47*.



Var. diffusa, nov.

Fig. 26. *P. gibba*, d'Orbigny. [*Polymorphina tubulosa*, Jones, Parker, and Brady, 1866.]

„ 27. *P. rotundata* (Bornemann). [*Globulina oviformis*, Terquem, 1878.]

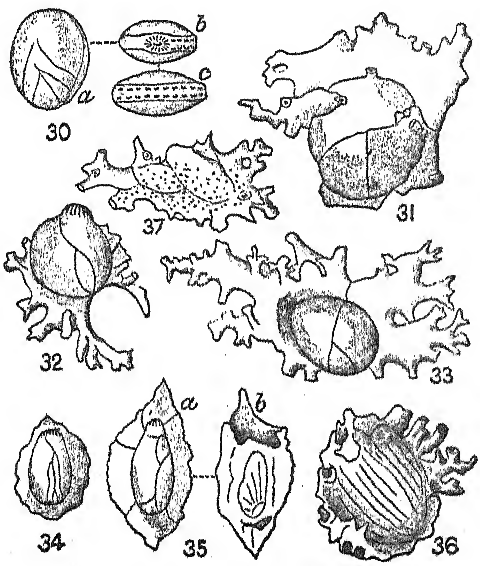
„ 28. *P. lactea* (Walker and Jacob). [*Polymorphina solidula*, Terquem, 1878.]

„ 29. *P. gutta*, d'Orbigny. [*Polymorphina gutta*, fistulose var., Chapman, 1896.]

SERIES IV.

Group No. 8.—Marginal Outgrowths.
Figs. 30–37.

Proposed varietal *name.*	*Salient characters of Outgrowths.*	*Nos. in detailed list*, pp. 508–516.
Var. *marginalis*, nov. Figs. 30–37.	*a.* Marginal (broken); no apical outgrowth.	*48.*
	b. Marginal, modified, racemose, chiefly at the oral end.	*49.*
	c. Marginal, chiefly at the aboral end ...	*50.*
	d. Marginal, lateral, and at the aboral end.	51.
	e. Marginal, more or less complete	52 and *53.*
	f. Marginal, attached, plate non-septate.	*54* and 55.
	g. Marginal, attached, plate septate	*56.*
	h. Marginal, striate surface to initial test and outgrowth smooth (? attached).	*57.*
	i. Marginal, racemose edges, aculeate (? attached).	*58.*



Var. MARGINALIS, nov.

Fig. 30 *a*, *b*, *c*. *P. Humboldtii*, Bornemann. *a*, lateral aspect; *b*, oral aspect; *c*, latero-peripheral aspect. [*Polymorphina communis* (part), Parker and Jones, 1857; *P. lactea*, var. *tubulosa*, Parker and Jones, 1865.]

" 31. *P. gibba*, d'Orbigny. [*Polymorphina gibba* (fistulose form), Brady, 1884.]

" 32. *P. gibba*, d'Orbigny. [*Polymorphina gibba*, Goës, 1894.]

" 33. *P. gibba*, d'Orbigny. [*Polymorphina gibba* (fistulose form), Wright, 1885.]

" 34. *P. lactea* (Walker and Jacob). [*Polymorphina concava*, Williamson, 1858.]

" 35 *a*, *b*. *P. lactea* (Walker and Jacob). *a*, lateral aspect of free surface; *b*, surface formerly attached. [*Polymorphina concava*, var. *dentimarginata*, Chapman, 1894.]

" 36. *P. regina*, Brady, Parker, and Jones. [*Polymorphina Orbignii* (striate-fistulose specimen), Brady, Parker, and Jones, 1870.]

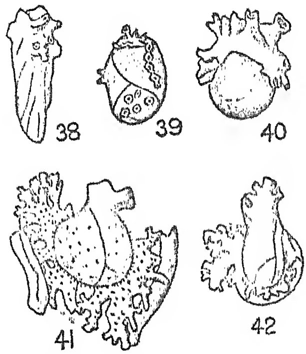
" 37. *P. compressa*, d'Orbigny. [*Polymorphina compressa* (fistulose form), Brady, 1884.]

SERIES V.

Group No. 9.—Mixed Outgrowths.

Figs. 38–42.

Proposed varietal *name*.	*Salient characters of Outgrowths.*	*Nos. in detailed list*, pp. 508–516.
Var. *complicata*, nov. Figs. 38–42.	*a*. Examples, figured by Soldani, of apical and marginal outgrowths.	59.
	b. Apical and sub-apical (broken, probably racemose).	60.
	c. Apical (broken), and limited patch of sub-apical.	61.
	d. Apical, sub-apical, and general surface (near racemose).	62.
	e. Apical and sub-apical (broken)	63.
	Apical and sub-apical	64 and 65.
	f. Apical cluster, and lateral (obscure)...	66.
	g. Apical and marginal, attached; surface aculeate.	67.
	h. Apical (broken) and marginal (? attached).	68.
	i. Apical, sub-apical, and marginal, attached.	69.



Var. COMPLICATA, nov.

Fig. 38. *P. angusta*, Egger. [*Polymorphina Orbignii*, Brady, Parker, and Jones, 1870.]
„ 39. *P. rotundata* (Bornemann). [*Globulina oviformis*, Terquem, 1878.]
„ 40. *P. gibba*, d'Orbigny. [*Globulina gibba*, Terquem, 1882.]
„ 41. *P. hirsuta*, Reuss. [*Polymorphina Orbignii*, Brady, Parker, and Jones, 1870.]
„ 42. *P. rotundata* (Bornemann). [*Polymorphina Orbignii*, Brady, Parker, and Jones, 1870.]

FISTULOSE POLYMORPHINÆ.

Series I.—Apical Outgrowths (page 501).

Group No. 1.—*Apical Crests.* Figs. 1–3.

1. 'Polymorpha corcula spinosa,' Soldani, 1791, Testaceograph. ac Zoophytograph. vol. i. part 2, p. 114, pl. 110. fig. P. Zoological type: *Polymorphina communis*, d'Orb. Recent; Mediterranean.
2. *Globulina transversa*, Terquem, 1882, Mém. Soc. Géol. France, sér. 3, vol. ii. Mém. 3, p. 129, pl. xiii. fig. 17. Zool. type: *Polymorphina gibba*, d'Orb. Eocene; Paris Basin.—Fig. 1.
3. *Guttulina problema*, Terquem, 1882, Mém. Soc. Géol. France, sér. 3, vol. ii. Mém. 3, p. 134, pl. xiii. fig. 44. Zool. type: *P. problema*, d'Orb. Eocene; Paris Basin.
4. *Polymorphina* (*Guttulina*) *damæcornis*, Reuss, 1845, Verstein. böhm. Kreidef. pt. i. p. 40, pl. xiii. fig. 85. Zool. type: *P. trigonula* (Reuss). Pläner-Mergel; Bohemia.—Fig. 2.

5. *Polymorphina regina*, var. fistulose form, Wright, 1886, Proceed. Belfast Nat. F. Club, Appendix IX, p. 331, pl. xxvii. fig. 13. Zool. type: *P. regina*, Brady, Parker, and Jones. Chalk; Keady Hill, North Ireland.—Fig. 3.
6. *Polymorphina compressa*, Goës, 1894, Kgl. Vet.-Akad. Handlingar, vol. xxv. no. 9, p. 58, pl. x. fig. 549. Zool. type: *P. compressa*, d'Orb. Recent; Coast of Norway.

Group No. 2.—*Apical Crowns.* Figs. 4 and 5.

7. *Polymorphina damæcornis*, Wright, 1875, Rep. and Proc. Belf. Nat. F. Club, vol. for 1873–74, Appendix III, p. 88, pl. iii. figs. 16 *a*, *b*. Zool. type: *P. gibba*, d'Orb. Chalk; North-East Ireland.—Fig. 4.
8. Chapman Collection. Zool. type: *Polymorphina gibba*, d'Orb. Gault; Folkestone. Outgrowth consisting of numerous tube-like extensions, breaking out peripherically from a flattened apical crown.—Fig. 5.

Group No. 3.—*Apical cushioned Outgrowths.* Figs. 6–9.

9. 'Polymorpha subovalia,' Soldani, 1791, Testaceographia, vol. i. pt. 2, p. 114, pl. 114. figs. D, E. Zool. type: *P. communis*, d'Orb. Recent; Mediterranean.
10. *Globulina tubulosa*, d'Orbigny, 1846, Foram. Foss. Vienne, p. 228, pl. xiii. fig. 16. Zool. type: *P. gibba*, d'Orb. Miocene Tertiary; Vienna.
11. *Polymorphina tubulosa*, Jones, Parker, and Brady, 1866, Monogr. Crag Foram. (Pal. Soc.), pl. i. fig. 71. [Also a reproduction by Brady, Parker, and Jones, 1870, in Trans. Linn. Soc. vol. xxvii. pl. xlii. fig. 38 *g*.] Zool. type: *P. gibba*, d'Orb. Pliocene; Suffolk.
12. *Globulina gibba*, Terquem, 1878, Mém. Soc. Géol. France, sér. 3, vol. i. no. 3, p. 43, pl. iv. (ix.) figs. 2 and 3 *a*, *b*. Also *Guttulina gravida*, Terquem, 1878, ibid. p. 47, pl. iv. (ix.) figs. 30 *a*, *b*. Zool. type: *P. gibba*, d'Orb. Pliocene; Island of Rhodes.—Figs. 6 *a*, *b*, *c* ("*gibba*"); figs. 7 *a*, *b* ("*gravida*").
13. *Polymorphina Roemeri*, Reuss (*P. diluta*, Born.), 1870, Sitzungsb. Ak. Wiss. Wien, vol. lxii. p. 485; Schlicht, 1870, Foram. Pietzpuhl, pl. xxxiv. figs. 4–12. Zool. type: *P. gutta*, d'Orb. Oligocene; Pietzpuhl, North Germany.—Fig. 8.

14. *Polymorphina lactea* (fistulose form), Brady, 1884, Chall. Rep. vol. ix. p. 560, pl. lxxiii. fig. 14. Zool. type: *P. communis*, d'Orb. Recent.—Fig. 9.
15. *Polymorphina sororia* (fistulose form), Brady, 1884, ibid. p. 562, pl. lxxiii. fig. 15. Zool. type: *P. sororia*, Reuss. Recent.

Group No. 4.—*Apical Cluster of Tubules.* Figs. 10–16.

16. 'Polymorpha subovalia,' Soldani, 1791, Testaceographia, vol. i. pt. 2, p. 114, pl. 115. fig. o. Zool. type: *P. communis*, d'Orb. Recent; Mediterranean.
17. *Globulina horrida*, Reuss, 1845, Verstein. böhm. Kreideform. pt. ii. p. 110, pl. xliii. fig. 14. Zool. type: *P. gutta*, d'Orb. Pläner-Mergel; Bohemia.—Fig. 10.
18. *Polymorphina horrida*, Burrows, Sherborn, and Bailey, 1890, Journ. Roy. Micr. Soc. p. 561, pl. xi. fig. 14. Zool. type: *P. fusiformis*, Römer. Red Chalk; Specton, Yorkshire.
19. *Polymorphina lanceolata*, Reuss, 1870, Sitzungsb. Ak. Wiss. Wien, vol. lxii. p. 487, no. 12; Schlicht, 1870, Foram. Septarienthones von Pietzpuhl, pl. xxxi. figs. 25–28. Also *Polymorphina gracilis*, Reuss, 1870, *l. c.* p. 486, no. 7; Schlicht, 1870, *l. c.* pl. xxxi. figs. 36, 37. Zool. type: *P. fusiformis*, Römer. Oligocene; Pietzpuhl, North Germany. —Figs. 11 & 12.
20. *Polymorphina Roemeri*, Reuss, 1870, Sitzungsb. Ak. Wiss. Wien, vol. lxii. p. 485; Schlicht, 1870, Foram. Pietzpuhl, pl. xxxiv. fig. 14. Zool. type: *P. gutta*, d'Orb. Oligocene; Pietzpuhl.
21. *Polymorphina prisca*, Berthelin, 1880, Mém. Soc. Géol. France, sér. 3, vol. i. Mém. no. 5, p. 57, pl. iv. (xxvii.) fig. 21. Zool. type: *P. fusiformis*, Römer. Gault; Montcley (Doubs), France.—Fig. 13.
22. *Globulina tubulosa*, d'Orbigny, 1846, Foram. Foss. Vienne, p. 228, pl. xiii. fig. 15. Zool. type: *P. gibba*, d'Orb. Miocene; Vienna.
23. *Aulostomella pediculus*, Alth, 1850, Haidinger Naturw. Abhandl. iii. p. 204, pl. xiii. fig. 17. Zool. type: *P. sororia*, Reuss. Cretaceous; Lemberg, East Galicia, Austria.
24. *Polymorphina horrida*, Wright, 1875, Rep. and Proc. Belfast Nat. F. Club, vol. for 1873–74, Appendix III, p. 85, pl. iii.

fig. 14. Zool. type; *P. fusiformis*, Römer. Chalk; North-East Ireland.—Fig. 14.

25. Chapman Collection. Zool. type: *P. fusiformis*, Römer. Gault; Folkestone.—The Polymorphine series of chambers agrees in form with *P. prisca* (Reuss), but the surface is rather thickly covered with fine prickles. Outgrowth apical, consisting of six or more limited tubes, which turn slightly outwards and downwards in a radial manner. The surface of the fistulose portion is also aculeate.—Fig. 15.
26. *Globulina horrida*, Reuss, 1850, Haid. Abhandl. iv. p. 43, pl. iv. fig. 8. Zool. type: *P. hirsuta*, Reuss. Chalk-marl; Lemberg.—Fig. 16.

Group No. 5.—*Apical and Racemose.* Figs. 17–23.

27. 'Polymorpha corcula spinosa,' Soldani, 1791, Testaceographia, vol. i. pt. 2, p. 114, pl. 110. fig. T. Zool. type: *P. gibba*, d'Orb. (?). Recent; Mediterranean.
28. *Polymorphina tubulosa*, Jones, Parker, and Brady, 1866, Monogr. Crag Foram. (Pal. Soc.), pl. i. figs. 74, 75. [Reproduction of fig. 74 as *P. Orbignii*, by Brady, Parker, and Jones, 1870, in Trans. Linn. Soc. vol. xxvii. pl. xlii. fig. 38 *c*.] Zool. type: *P. gibba*, d'Orb. Pliocene; Suffolk.—Fig. 17.
29. *Polymorphina tubulosa*, Jones, Parker, and Brady, 1866, Monogr. Crag Foram. (Pal. Soc.), pl. i. fig. 72. Zool. type: *P. gibba*, d'Orb. Pliocene; Suffolk.—Fig. 18.
30. *Polymorphina damæcornis*, Wright, 1875, Rep. and Proc. Belfast Nat. F. Club, vol. for 1873–74, Appendix III, p. 85, pl. iii. fig. 17. Zool. type: *P. gibba*, d'Orb. Chalk; North-East Ireland.
31. *Globulina oviformis*, Searles Wood, MS., about 1846. Zool. type: Near *P. lactea* (W. & J.). Pliocene; Suffolk. Apical outgrowth racemose, sessile, and regularly branched. —Figs. 19 *a*, *b*.
32. *Polymorphina prælonga*, Terquem, 1878, Mém. Soc. Géol. France, sér. 3, vol. i. no. 3, p. 39, pl. iii. (viii.) fig. 21. *P. amygdaloides*, idem, ibid. p. 39, pl. iii. (viii.) fig. 28. Zool. type: *P. lactea* (W. & J.). Island of Rhodes.—Fig. 20.
33. *Polymorphina hirsuta*, Reuss, 1870, Sitzungsb. Ak. Wiss. Wien, vol. lxii. p. 486; Schlicht, 1870, Foram. Septarienthones von Pietzpuhl, p. 88, pl. xxxiv. figs. 1–3. Zool. type:

50. *Polymorphina gibba*, Goës, 1894, Kgl. Vet.-Akad. Handl. vol. xxv. no. 9, p. 55, pl. ix. fig. 522. Zool. type: *P. gibba*, d'Orb. Recent; Coast of Norway.—Fig. 32.

51. *Misilus aquatifer*, Montfort, 1808, Conch. Syst. vol. i. p. 294, 74^e genre. See Ann. Mag. Nat. Hist. ser. 3, vol. vi. 1860, p. 345. Zool. type: *P. lactea* (W. & J.). Recent; Mediterranean.

52. 'Polymorpha corcula spinosa,' etc., Soldani, 1791, Testaceographia, vol. i. part 2, p. 114, pl. 109. figs. G, M, L; pl. 110. figs. N, S; pl. 111. figs. X, *a a*, *c c*, *d d*. Zool. type: *P. gibba*, d'Orb. Recent; Mediterranean.

53. *Polymorphina gibba* (fistulose form), Wright, 1886, Proceed. Belfast. Nat. F. Club, 1884–85, Appendix, 1886, p. 324, pl. xxvi. fig. 11. Zool. type: *P. gibba*, d'Orb. Recent; Belfast Lough.—Fig. 33.

54. *Polymorphina concava*, Williamson, 1858, Recent. Foram. Gt. Britain, p. 72, pl. vi. figs. 151, 152; refigured by Brady, Parker, & Jones, 1870, Trans. Linn. Soc. vol. xxvii. p. 236, pl. xl. figs. 32, *a*, *b*. Zool. type: *P. lactea* (W. & J.). Recent; British coast.—Fig. 34.

55. *Polymorphina concava*, R. Jones, Monogr. Crag Foram. Part II. 1895, pl. v. fig. 22 (Millett's Collection). Zool. type: *P. lactea* (W. & J.). Pliocene; Suffolk.

56. *Polymorphina concava*, var. *dentimarginata*, Chapman, 1894, Quart. Journ. Geol. Soc. vol. l. p. 717, pl. xxxiv. figs. 14 *a*, *b*. Zool. type: *P. lactea* (W. & J.). Lower Greensand; Surrey.—Outgrowth a shelly capsule surrounding the initial test, lengthened and acuminate at the oral and aboral extremities, the edge finely accrate. The whole of the capsule is septate, divided into about five chambers. The surface of attachment, together with the initial test, is perfectly flat and smooth.—Figs. 35 *a*, *b*.

57. *Polymorphina Orbignii* (striate-fistulose specimen), Brady, Parker, and Jones, 1870, Trans. Linn. Soc. vol. xxvii. p. 244, pl. xlii. fig. 38 *m*. Zool. type: *P. regina*, B., P., & J. Pliocene; Suffolk.—Fig. 36.

58. *Polymorphina compressa* (fistulose form), Brady, 1884, Chall. Reports, vol. ix. p. 566, pl. lxxiii. fig. 17. Zool. type: *P. compressa*, d'Orb. Recent.—Fig. 37.

SERIES V.—MIXED OUTGROWTHS (page 507).

Group No. 9.—*Apical, Subapical, Marginal, &c.*
Figs. 38–42.

59. 'Polymorpha corcula, spinosa,' etc., Soldani, 1791, Testaceographia, vol. i. part 2, p. 114, pl. 109. fig. K; p. 114, pl. 110. figs. O, Q, R, V; p. 114, pl. 111. figs. Y, Z, *b b*; p. 116, pl. 121. figs. *h h*, *l l*. Zool. type: *P. gibba*, d'Orb., etc. Recent; Mediterranean.
60. *Polymorphina tubulosa*, Jones, Parker, and Brady, 1866, Monogr. Crag Foram. (Pal. Soc.), pl. i. fig. 70. [See also reproduction=*P. Orbignii*, Brady, Parker, & Jones, 1870, Trans. Linn. Soc. vol. xxvii. p. 244, pl. xlii. fig. 38*f*.] Zool. type: *P. gibba*, d'Orb. Pliocene; Suffolk.
61. *Polymorphina Orbignii*, Brady, Parker, and Jones, 1870, Trans. Linn. Soc.. vol. xxvii. p. 244, pl. xlii. fig 38 *e*. Zool. type: *P. angusta*, Egger. Recent.—Fig. 38.
62. *Globulina oviformis*, Terquem, 1878, Mém. Soc. Géol. France, sér. 3, vol. i. no. 3, p. 44, pl. iv. (ix.) fig. 12. Zool. type: *P. rotundata* (Born.). Pliocene; Island of Rhodes.—Fig. 39.
63. *Aulostomella dorsigera*, Costa, 1856, Atti Acad. Pontaniana, vol. vii. fasc. 2, p. 281, pl. xviii. figs. 20 *a*, A, B. Zool. type; *P. sororia*, Reuss. Tertiary; Cannitella, Calabria.
64. *Apiopterina Orbignii*, Zborzewski, 1834, Nouv. Mém. Soc. Imp. Nat. Moscou, vol. iii. p. 311, pl. 28. fig. 2 *b*. Zool. type: *P. lactea* (W. & J.). Tertiary; South-West Russia.
65. *Globulina gibba*, Terquem, 1882, Mém. Soc. Géol. France, sér. 3, vol. iii. Mém. 3, p. 130, pl. xiii. fig. 22. Zool. type: *P. gibba*, d'Orb. Eocene; Septeuil, near Paris.—Fig. 40.
66. *Polymorphina horrida*, Wright, 1875, Rep. & Proc. Belf. Nat. F. Club, vol. for 1873–74, Appendix III, 1875, p. 85, pl. iii. fig. 15. Zool. type: *P. lactea* (W. & J.). Upper Cretaceous; North Ireland.
67. *Polymorphina Orbignii*, Brady, Parker, and Jones, 1870, Trans. Linn. Soc. vol. xxvii. p. 244, pl. xlii. fig. 38 *i*. Zool. type: *P. hirsuta*, Reuss. Recent; English Channel.—Fig. 41.
68. *Polymorphina lactea*, var. *fistulosa*, Williamson, 1858, Rec. Foram. Gt. Brit. p. 72, pl. vi. fig. 150. Also figured as *P. Orbignii* by Brady, Parker, and Jones, 1870, Trans. Linn.

Soc. vol. xxvii. p. 244, pl. xlii. fig. 38 *d*. Zool. type: *P. compressa*, d'Orb. Recent; Coast of Britain.

69. *Polymorphina Orbignii*, Brady, Parker, and Jones, 1870, Trans. Linn. Soc. vol. xxvii. p. 244, pl. xlii. fig. 38 *j*. Zool. type: *P. rotundata* (Born.). Pliocene; Suffolk.—Fig. 42.

TABULAR SYNOPSIS of the Fistulose *Polymorphinæ*, showing the relative proportion of the several Species to the Groups or Varieties described above; and arranged on the basis of the foregoing catalogue.

Varieties........	1.	2.	3.	4.	5.	6.	7.	8.	9.
Polymorphina									
communis ...	*	......	**	*	......	......	*		
gibba	*	*	**	*	***	*	*	***	**
problema ...	*	......	......	......	......	*			
trigonula ...	*								
sororia	......	......	*	*	......	......	......	......	*
gutta	......	......	......	*	......	......	*		
hirsuta	......	......	......	*	*	......	......	......	*
fusiformis ...	......	......	......	***	*				
virgata	......	......	......	......	*				
lactea	......	......	......	......	**	......	......	***	
rotundata ...	......	......	......	......	......	......	*	......	*
Humboldtii	......	......	......	......	......	......	......	*	
regina........	......	......	......	......	......	......	......	*	
compressa ...	......	......	......	......	......	......	......	*	*
angusta	......	......	......	......	......	......	......	......	*

Note.—The asterisks indicate occurrence and relative abundance.

Varieties:—1. *damæcornis*, Reuss; 2. *coronula*, nov.; 3. *acuplacenta*, nov.; 4. *horrida*, Reuss; 5. *racemosa*, nov. (1–5; Series I, apical growths): 6. *circularis*, nov. (Series II, subapical): 7. *diffusa*, nov. (Series III, diffuse): 8. *marginalis*, nov. (Series IV, marginal): 9. *complicata*, nov. (Series V, mixed).

It will of course be obvious that, in many cases, these varietal names will have to be applied to more than one species of the genus, since the latter, as a whole, shows a strong tendency to take on one or more of these redundant fistulose outgrowths.

From this Table it is evident that *Polymorphina gibba* supplies by far the greatest number and the greatest variety of exogenous growths in this genus; in fact, showing examples of each kind.

Note on the Formation of the Epiphragm of *Helix aspersa*. By Prof. G. J. Allman, M.D., F.R.S.

[Read 18th June, 1896.]

The mode of formation of the epiphragm or temporary lid by which our common garden snail (*Helix aspersa*) closes the aperture of its shell on the approach of winter, and during the continuance of hot and dry weather, does not appear to have been as yet satisfactorily described.

The epiphragm of various species of *Helix* forms the subject of a memoir by Fischer *, who erroneously assigns its formation to a secretion from the foot. Binney † has made some interesting observations on its formation in *Helix hortensis*, and attributes it to the collar or adherent mantle-margin—a conclusion which, so far as it goes, is correct, but he takes no notice of any special modification by which this part of the animal may become fitted for the duties assigned to it. Vogt and Yung ‡ refer to its formation in *Helix pomatia*; and while they also regard it as a secretion from the collar, they enter into no further anatomical or physiological details.

In *Helix aspersa* the epiphragm is formed by a secretion from the surface of a specially modified area of the mantle-margin. It will be borne in mind that in *Helix*, as in other terrestrial representatives of the testaceous pulmonary Gastropods, the proper mantle possesses no free mantle skirt, but is represented by the general integument of the body (*pl.*), terminating ventrally in an even rounded and slightly thickened and everted margin, which, like the rest of the mantle, except where it lies over the respiratory chamber, is adnate to the surface of the body. This rounded mantle-margin is the so-called collar. From its whole extent there is developed a thin glandular fold (*c.i.*) which is inflected over the ventral side of the snail, where it forms a centrally perforated muscular disc. On retraction of the animal within its shell, this can be extended centripetally, so that its inner edge may reach the centre, and thus completely close the aperture. It is from the

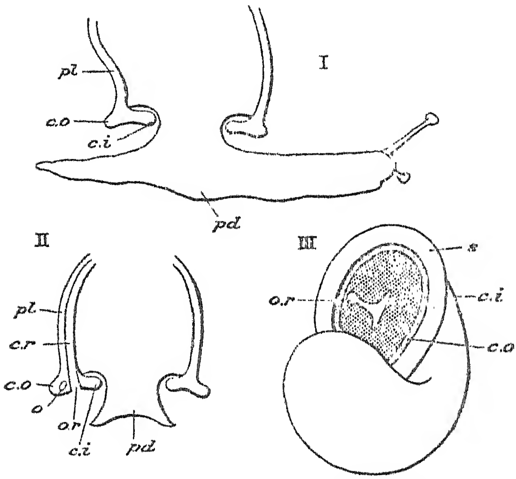
* Paul Fischer, "De l'Epiphragme et de sa formation," Journ. de Conchyliologie, 1853, vol. iv. p. 397.

† W. G. Binney, "The Terrestrial Air-breathing Molluscs of the United States," Bull. Mus. Comp. Zool. Harvard Coll., vol. iv. 1878.

‡ Carl Vogt et Émile Yung, 'Traité d'Anatomie Comparée pratique,' 1888, vol. i. p. 772.

outer surface of this inflected inner collar-lobe or *phragmatogenic disc* that the epiphragm is mainly formed, as a mucous secretion which soon hardens into a thin membrane of horny consistency, and which may increase in thickness by successive deposits from the disc.

By the contraction of the inflected disc an open space of greater or less extent will be left in its centre, and through this



Formation of the Epiphragm in *Helix aspersa.*

I. Longitudinal dorso-ventral section through ventral region.
II. Transverse dorso-ventral section through ventral region.
III. Front view of aperture of shell, showing the inflected disc for the secretion of the epiphragm.

c.i. Mantle-rim. Inner collar-lobe or phragmatogenic disc. (In I. and II. with the central opening expanded for the protrusion of the ventral region of the snail. In III. with the central opening nearly closed.)
c.o. Mantle-rim ("collar") on the collar-lobe.
c.r. Respiratory chamber.
o. Osphradium ?
o.r. Respiratory orifice. (In III. showing the fissure which connects the orifice with the central opening.)
pd. Foot.
pl. Mantle coincident with the general integument.
s. Margin of shell.

The figures are diagrammatic.

the foot and head of the snail may be protruded and again entirely withdrawn.

Close to the rim of the mantle, on the right side of the animal, the disc is perforated by the respiratory orifice (*o.r.*) leading directely into the respiratory chamber (*c.r.*). This orifice is connected with the central aperture of the disc by a fissure (fig. III.), which, like the central aperture, can be closed by the approximation of its edges.

When the epiphragm is about to be formed, the foot and head of the snail are much contracted and entirely withdrawn deep into the shell through the central opening in the disc, which is then completely closed, leaving an even continuous surface for the secretion of the epiphragm.

Immediately over the site of the respiratory orifice the epiphragm is perforated by a small aperture which affords access from without to the atmospheric air, which even during the period of repose may still be needed for respiration—a function which during the dormancy of the animal is probably not quite arrested *.

Access to the atmospheric air is also probably connected with the presence of an osphradium or olfactory organ, which may perhaps be recognized in a small patch of modified ectoderm (*o*, fig. II.) visible close to the edge of the respiratory orifice.

It may also be noted that the perforation of the epiphragm has an uneven edge, and gives the impression of having been caused by the action of some solvent on the substance of the epiphragm. When we bear in mind that it is in close proximity with the respiratory orifice, that exit is given to the renal secretion as well as to the contents of the alimentary canal after this has received the secretion of the digestive gland (so-called liver), we shall perhaps deem it not improbable that some of these secretions have acted as a solvent on the epiphragm, the orifice of which is situated exactly in the position best fitted to bring it within reach of their action.

When the conditions which call for the formation of an epiphragm are present, the snail seeks for some surface to which it may apply the aperture of its shell in such a way as to exclude the free access of the external air. This may be the shell of

* I have never met with *Helix aspersa* in a state of hybernation in which the perforation of the epiphragm was not present; and yet I can find no published account of it. In conversation, however, with Col. Godwin-Austen, whose researches among the terrestrial Gastropods have contributed so largely to our knowledge of these animals, I found that its existence was well known to him.

another snail; and we frequently find during the winter months large colonies of hybernating snails attached firmly to one another. After selecting a suitable locality the first act is to throw out from the mantle-margin, in which the secreting function would seem to be especially active, sufficient material to glue the edge of the shell firmly to the subjacent surface. When this has been accomplished, the epiphragm is completed by a secretion from the general surface of the phragmatogenic disc.

On the approach of spring, and when the conditions rendering necessary the presence of an epiphragm no longer exist, the snail once more awakens from its sleep, and the central opening in the phragmatogenic disc again makes its appearance, and gives exit to the foot and head of the snail, which then, pressing on the membranous epiphragm, rupture it, and thus allows the animal to enter freely into all its relations with the surrounding medium.

Descriptions of new Species of *Forficulidæ* in the Collection of the British Museum (Nat. Hist.), S. Kensington. By W. F. Kirby, F.L.S., F.E.S.

[Read 18th June, 1896.]

(Plate XX.)

Since the publication of my "Revision of the *Forficulidæ*" (Linn. Soc. Journ., Zool. vol. xxiii. pp. 502–531), little of importance has been published on the family, except an article by De Bormans in the 'Biologia Centrali-Americana,' and the descriptions of a few new species by De Bormans, Brunner von Wattenwyl, and others. *Forficulidæ* are insects which are seldom collected, and they generally arrive as single specimens, which are frequently damaged, or, if perfect, are not sufficiently well marked to render it advisable to characterize them from a single specimen, necessarily representing only one sex. Consequently, I have only about a dozen new species to describe in the present paper; but some of them are extremely handsome and remarkable forms acquired from the collection of the late Mr. Pascoe and from other sources.

There is an error in my Table of Genera (pp. 504–505 of the above-quoted paper), which it may be as well to take the present opportunity of conspicuously rectifying. On p. 504, 2nd &

3rd cols., line 9, for "*Brachylabis.* S. America, Java," read "*Anisolabis.* General Distribution"; and on p. 505, 2nd & 3rd cols., line 8, for "*Anisolabis.* General Distribution," read "*Brachylabis.* S. America."

Genus Apachys, *Serv.*

Apachys Pascoei, sp. n. (Pl. XX. fig. 1.)

Long. corp. (absque forcip.) 35 millim.; lat. 7 millim.; long. tegm. 10 millim.; al. 5; term. segm. cum pygid. 10; long. forcip. 8.

Male. Head black, shining; a deep semicircular depression between the eyes on the vertex; face below the antennæ testaceous, blackish at the lower end of the clypeus. Antennæ broken (15 joints remaining), blackish brown, the second joint reddish; scape broad, about twice as long as broad, testaceous at the extremity; the 2nd transverse, the 3rd twice as long as broad, the 4th, 5th, and 6th transverse, the remainder gradually lengthening, but the last remaining hardly twice as long as broad. Thorax black, shining, longer than broad, narrowed in front; scutellum triangular, very large; a central groove running from the occiput to the scutellum; elytra shading into chocolate-brown or reddish, the basal two-thirds slightly lobate at the sides, where they are edged with whitish. Visible portion of the wings yellow in the middle, and more ochreous outwardly. Abdomen reddish, blackish towards the sides, the front segments longitudinally striated, the terminal segment strongly granulated; the pygidium very large, subrotund, obtusely angulated at the extremity, with the lateral angles indicated by slight projections. Forceps nearly semicircular, but incurved before the middle, beyond which they are slightly flattened; a strong ridge on the inner side at the base. Legs smooth, shining, blackish, shading into chocolate-brown or testaceous; femora thickened; second joint of tarsi very small, third joint nearly twice as long as second.

Hab. Sylhet.

The genera *Apachys* and *Tagalina* are generally characterized as having the first joint of the tarsi no longer than the second; but this is by no means an invariable character. *Apachys*, however, may be recognized at once by the semicircular forceps, placed before the base of the very large pygidium. The present species is from the collection of the late Mr. F. P. Pascoe, and

is one of the finest earwigs known, being nearly twice as large as any previously described species of *Apachys*, and equalling a *Pygidicrana* in size.

The specimen is carded, which interferes with a complete examination. This is the first species recorded from the mainland of Asia, though the genus occurs in Africa, Borneo, Sumatra, and New Guinea. It appears to be most nearly allied to *A. Beccarii*, Dubrony, from New Guinea, but the latter is a much smaller species, with the exposed part of the wings broadly bordered with brown.

Genus PYGIDICRANA, *Serv.*

PYGIDICRANA FORCIPATA, sp. n.

Long. corp. (absque forcip.) 23·5 millim.; long. forcip. 10 millim.

Male. Head black, clypeus testaceous below, lower mouth-parts reddish. Vertex testaceous in the middle, this colour projecting in two points both in front and behind, and also on each side, behind the eye. Antennæ with at least 30 joints, brown; the scape testaceous, pyriform, and much expanded; the flagellum with the joints towards the base transverse, but the succeeding ones gradually becoming longer and thinner. Pronotum half as long again as broad, convexly narrowed in front, and also slightly narrowed, but truncated, behind; testaceous, with two black bands, diverging beyond the middle but nearly meeting behind. Scutellum yellowish, forming a slightly acute triangle; a narrow groove runs from the occiput to the scutellum. Tegmina blackish; projecting portions of wings testaceous. Abdomen blackish, dull; terminal segment and forceps more shining, somewhat castaneous, and expanded. Forceps with a projection on the inside at the base, ending in three blunt teeth, then curving round, and projecting a tooth inwards at two-thirds of their length, beyond which they are nearly straight, very distinctly denticulated on the inner edge, and terminating in a sharp hook turned inwards. Legs testaceous, femora more or less varied with black, broad, flattened, and strongly carinated in the middle.

Hab. Para.

From the collection of the late Mr. F. P. Pascoe.

Allied to *P. v-nigra*, Serv., but the black tegmina and the different form of the forceps are amply sufficient characters for its identification.

PYGIDICRANA EGREGIA, sp. n. (Pl. XX. fig. 3.)

Long. corp. (absque forcip.) 30 millim.; long. forcip. 8 millim.

Female. Head black, the greater part of the head behind the eyes covered by a testaceous patch not extending to the margins, narrowed in front, and ending in a sharp projection on each side before the eye; palpi reddish, testaceous towards the base. Antennæ 35-jointed; scape testaceous, black at the tip, twice as broad as long, and stouter than the flagellum. Flagellum reddish brown, darkest at the extremity; the first two joints a little broader than long, the next three annular, the remainder longer than broad and generally lengthening, the last five slenderer than the rest. Pronotum almost globular, truncated behind, testaceous, narrowly edged with black in front, and with a thick U-shaped mark, with a heavy base, resting on the hinder margin. Scutellum yellow. Tegmina black, with two wide testaceous bands running from the base—one spindle-shaped, ceasing at about two-thirds of the length of the tegmina; the other lateral, submarginal, and extending for the whole length of the tegmina, except for the outer black edging. Projecting portion of wings testaceous, with the outer half brown. Abdomen stout, pubescent, with the sides nearly parallel; the terminal segment thickly granulated. Forceps very thick, converging to a point at the extremity, a strong ridge above at the base, the lower inner edge denticulate, especially towards the base; a rather stronger tooth just beyond the middle. Legs testaceous, slightly lined with black, and with the joints marked with black.

Hab. Santa Catharina.

From the collection of the late Mr. F. P. Pascoe.

A very fine species, allied to *P. v-nigra*, Serv., but larger, darker, and with longer forceps.

Genus CYLINDROGASTER, *Stål.*

I cannot agree with De Bormans in regarding the genus *Cylindrogaster*, Stål, as the same as *Diplatys*, Serv., though I have not yet seen a specimen of the latter genus.

CYLINDROGASTER NIGRICEPS.

Cylindrogaster nigriceps, Kirb. Journ. Linn. Soc., Zool. xxiii. p. 507 (1890).

This species was described from Hong Kong. Other specimens have since been received from Bombay and Ceylon.

CYLINDROGASTER RUFESCENS, sp. n. (Pl. XX. fig. 2.)

Long. corp. cum forcip. 11 millim.; segm. term. cum forcip. 2·3 millim.

Female. Head, pronotum, tegmina, and exposed part of wings reddish chestnut; mouth-parts yellow, with a transverse reddish band, and reddish beneath; antennæ light reddish brown, with yellow incisions; legs yellow, femora and tibiæ mostly reddish in the middle. Wings extending beyond the tegmina for fully half the length of the latter; pronotum rather large, the sides and hinder border lighter, slightly raised, bordered within by a rather distinctive blackish U-shaped mark. Abdomen rufo-testaceous, the forceps, and the greater part of the terminal segment reddish. Forceps as long as the latter, stout, contiguous, incurved and pointed at the tips.

Hab. North India (*Capt. Reid*).

This is a stouter insect than the female of *C. nigriceps*, and differs from it also in its colour, larger pronotum, and longer wings.

Genus LABIDURA, *Leach.*

LABIDURA (?) WALKERI, sp. n. (Pl. XX. fig. 6.)

Long. corp. cum forcip. 22 millim.; long. forcip. 8·5 millim.

Male. Rufo-castaneous, pubescent; head and pronotum black, shining, clypeus bordered below with testaceous, palpi yellowish; antennæ testaceous, shading into brown; legs testaceous. Pronotum rather longer than broad, with a central groove, crossed by a transverse one beyond the middle, and with two slight depressions in front. Exposed part of the wings rounded off at the sides; the suture testaceous. Abdomen with segments 3–5 with a moderate-sized lateral spine on each; segment 2 with a small tubercle; segments 2–7 with a double row of short striæ in front, on each side of the back; terminal segment slightly grooved in the middle, and finely punctured towards the sides. Forceps nearly straight, slightly curved inwards in the middle, and then again outwards, the points turned rather sharply inwards at the extremity. No projecting teeth, but a row of small denticulations towards the base on the lower edge.

Hab. Hong Kong (*J. J. Walker*).

Differs from all the described species of the group of *L. sex-*

spinosa, Dohrn, by the absence of large teeth on the inner edge of the forceps.

The spiny *Labiduræ* should form a new genus, but I have not sufficient materials before me at present to characterize it.

Genus Psalis, *Serv.*

Psalis borneensis, sp. n.

Long. corp. cum forcip. 21 millim.; lat. 5 millim.; long. segm. term. cum forcip. 7 millim.

Female. Black, shining, with long scattered setæ on the legs and sides of the body. Antennæ with 10 joints preserved; scape linear, about thrice as long as broad; joints 3 and 4 moniliform, the rest longer than broad, those of the flagellum bearing short whorls of hair. Pronotum about as broad as long, with a central groove, not extending to the hinder part, which is somewhat raised; the sides are also raised. Exposed part of wings obtuse, with a reddish spot at the base of the suture and a larger one beyond it. Abdomen not tuberculate, thickly but rather finely punctured, and milled at the extremities of the segments; terminal segment longitudinally punctate-striate, and grooved in the middle. Forceps rather longer than the terminal segment, very stout, contiguous, hooked at the extremity, with about 3 short obtuse teeth on the inside towards the base. Femora smooth, expanded, and hollowed beneath; tarsi clothed beneath with golden hair, the second joint with a tuft projecting beneath the third.

Hab. Baram, N.W. Borneo.

Closely allied to *Psalis indica*, Burm., of which it may even be a melanotic form. *P. indica* was placed by Dohrn in *Labidura*, but is certainly much nearer allied to the American species of *Psalis.*

Genus Anisolabis, *Fieber.*

Anisolabis occidentalis, sp. n. (Pl. XX. fig. 5.)

Long. corp. 20 millim.; segm. term. cum forcip. 5 millim.

Female. Head reddish, shining; antennæ and legs testaceous yellow. Antennæ 20-jointed; scape linear, stouter than the flagellum; 3rd joint twice as long as broad; 2nd, 4th, and 5th about as long as broad, the rest becoming gradually longer; thoracic segments rufo-testaceous, obsoletely bordered behind with blackish. First segment of abdomen blackish brown, with a dark red shine; abdomen finely punctured, most distinctly

towards the extremity. Forceps longer than the last segment, very stout, contiguous at the base and curving inwards at the tips; towards the base is a strong tooth on the inner edge, which is finely denticulated beyond.

Hab. Cape Leeuwin, W. Australia.

Described from two specimens. Resembles *A. littorea*, White, from New Zealand, but is more slender, lighter in colour, and the forceps is differently formed.

Genus Sparatta, *Serv.*

Sparatta apicalis, sp. n. (Pl. XX. fig. 7; 7 *a*, pygidium and forceps.)

Long. corp. cum forcip. 10 millim.; segm. term. cum forcip. 3 millim.

Shining black, mouth-parts testaceous; antennæ dirty yellowish brown, the joints white at the base; head with a conspicuous white line crossing the vertex before the occiput, and running round the front of the clypeus; legs dirty yellow, the femora brown; terminal segment luteous, often more or less blackish in the middle. Forceps luteous, gradually curved, denticulated to the middle on the upper and inner carinæ, and with a small tooth about the middle of the latter; in the male, the tips are black, and more strongly incurved than in the female. Pygidium in the male short, broad, with a tubercle at the sides, and barely convex in the middle; in the female almost square, with a tubercle at the angles, and the centre but slightly projecting in a very obtuse angle.

Hab. Theresopolis (*Fruhstorfer*); Rio (*Fry*).

A very distinct species, probably allied to *S. pelvimetra*, Serville; but in that species the abdomen is described as reddish fulvous, with the extremity darker.

Sparatta Clarkii, sp. n. (Pl. XX. figs. 8; 8 *a*, pygidium and forceps.)

Long. corp. cum forcip. 14 millim.; segm. term. cum forcip. 7 millim.; long. forcip. 3·5 millim.

Head, pronotum, tegmina, and exposed part of wings black and shining, lower edge of clypeus grey, palpi luteous. Antennæ with the scape and the short 2nd joint black, the latter more or less reddish; the following joints reddish to about the 8th or

9th, when they again become black. Abdomen, forceps, and legs luteous, the terminal joint of the abdomen often blackish, and the tibiæ always black. Forceps flattened, triquetral, with a row of tubercles on the upper ridge, and also on the inner ridge, to beyond the middle, where there is a strong triangular tooth; the tips strongly and suddenly incurved; in the female these characters are less strongly marked. In the male the pygidium is short and rounded; in the female it is long and narrow, twice as long as broad, with a strong tubercle at each angle, and the centre triangularly pointed.

Hab. Tejuca, Petropolis, and Constancia (*Rev. Hamlet Clark*); Theresopolis (*Fruhstorfer*).

Sparatta pygidiata, sp. n. (Pl. XX. fig. 10; 10 *a*, pygidium and forceps.)

Differs very slightly from the last species in colour, except that the terminal segment is less frequently marked with blackish, and the tibiæ are more brown than black, and the elytra, &c. have a slight purplish shine. In the male, the pygidium is shorter, broader, and less convex than in *S. Clarkii*, and the tubercles on the lower carina of the basal half of the forceps before the tooth are more regularly arranged. In the female, the pygidium is very short and broad (much broader than long), with a much shorter projection in the middle.

Hab. Rio Janeiro (*Fry*).

These species are so closely allied that they can only be separated by the different shape of the pygidium, which is most conspicuous in the female. They are allied to *S. rufina*, Stål, and *S. Schotti*, Dohrn, and are perhaps confounded with them in collections. *S. pygidiata* answers so well to Stål's description of *S. rufina*, that I should have regarded it as that species, but that Stål does not mention the strong central tooth on the inner edge of the forceps beyond the denticulations. Dohrn's description is shorter than Stål's, but he compares the species with *S. pelvimetra*, Serville, which has the forceps very sharply angulated. He also mentions that the scape of the antennæ was black in his specimens; the rest being red. Stål says: "Antennis articulis subelongatis, flavotestaceis, extus fuscescentibus." The British Museum at present possesses no specimen which I can refer to the true *S. rufina*. The male specimen from Guatemala, described and figured by De Bormans in the 'Biologia

Centrali-Americana' as "*Sparatta pelvimetra* var. *rufina*," agrees with the descriptions of typical *S. pelvimetra*, Serville, even to the thorax being reddish; and as such I shall regard it, unless further material, when obtained, proves it to be a distinct species.

Sparatta Clarkii and *S. pygidiata* differ from *S. Schotti*, Dohrn, in the antennæ. Those of *S. Schotti* are described as brown, with joints 9–12 pale. There is a female specimen labelled *S. Schotti* from Mexico in the Godman and Salvin collection, which has brown antennæ, with the two basal joints blackish (8 only preserved). The pygidium is moderately long and broad, with the lateral angles well marked, and the central part projecting rectangularly and longer than the basal part. It is evidently distinct, for the head and pronotum, which ought to be red in typical *S. Schotti*, are shining black. It may be called *S. Bormansi*.

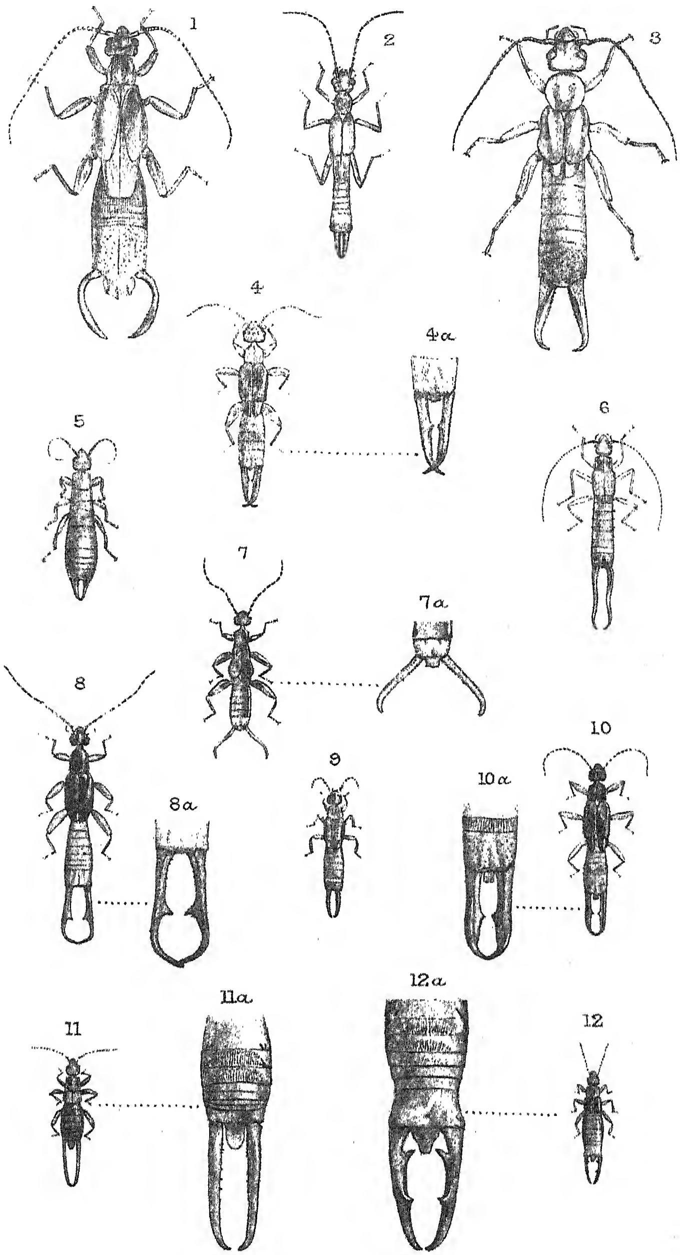
SPARATTA SEMIRUFA, sp. n. (Pl. XX. figs. 4, 4 *a*.)

Long. corp. cum forcip. 10–12 millim.; long. forcip. 2–3·5 millim.

Rufo-testaceous; tegmina and exposed part of wings violet-black, shining; antennæ 14-jointed, and, as well as the palpi, luteous or brownish yellow; head with a large square brownish patch in front, mouth-parts clothed with yellowish hair; pronotum usually with a short dark dash on each side; elytra with the margins, and sometimes the base, shading more or less into testaceous. Forceps long, with the basal half nearly straight, and with several serrations on the inner edge as far as a strong tooth just beyond the middle, then gradually incurved. In the female they are stouter, and the tooth, which is placed before the middle, is much smaller and more obtuse, and the denticulations preceding it are much smaller than in the male. The pygidium in both sexes is short and broad, with the lateral angles projecting strongly outwards, and the central part moderately convex.

Hab. Igaurassu (near Pernambuco), Brazil.

This species agrees with the very brief description of *S. Schotti*, Dohrn, except that in *S. Schotti* the antennæ should be brown, with joints 9–12 pale.


1
2
3
4
4a
5
6
7
7a
8
8a
9
10
10a
11
11a
12a
12

Genus Sphingolabis, *De Bormans*.

I have taken the present opportunity of figuring three interesting species of this genus, which, though previously described, had not been figured before.

Sphingolabis variegata. (Pl. XX. fig. 9.)

Sphingolabis variegata, Kirb. Journ. Linn. Soc., Zool. xxiii p. 526 (1891).

Hab. Sierra Leone.

Sphingolabis (?) subaptera. (Pl. XX. figs. 12, 12*a*.)

Sphingolabis (?) *subaptera*, Kirb. Journ. Linn. Soc., Zool. xxiii. p. 527 (1891).

Hab. Queensland.

Sphingolabis Erichsoni. (Pl. XX. figs. 11, 11*a*.)

Apterygida Erichsoni, Dohrn, Stett. ent. Zeit. xxiii. p. 231, note (1862).

Forficula ruficeps, Erichson (nec Burm.), Arch. f. Nat. viii. (1) p. 246 (1842).

Hab. Tasmania.

A conspicuous species, easily recognizable by Erichson's diagnosis alone, even without his more detailed description: "Nigra, nitida, capite forcipeque rufis, pedibus testaceo-variis."

EXPLANATION OF PLATE XX.

Fig. 1. *Apachys Pascoei.*
2. *Cylindrogaster rufescens.*
3. *Pygidicrana egregia.*
4, 4 *a.* *Sparatta semirufa.*
5. *Anisolabis occidentalis.*
6. *Labidura Walkeri.*
7, 7 *a.* *Sparatta apicalis.*
8, 8 *a.* *Sparatta Clarkii.*
9. *Sphingolabis variegata.*
10, 10 *a.* *Sparatta pygidiata.*
11, 11 *a.* *Sphingolabis Erichsoni.*
12, 12 *a.* *Sphingolabis* (?) *subaptera.*

Figures 1, 3, 5, 6, 9, 11, and 12 are represented of the natural size; figures 2, 4, 7, 8, 10 are enlarged twice. The separate figures of the forceps &c. are enlarged four times, except fig. 11*a*, which is enlarged only three times.

The Mesial Fins of Ganoids and Teleosts. By Professor T. W. Bridge, D.Sc. (Communicated by Prof. G. B. Howes, Sec. Linn. Soc.)

[Read 18th June, 1896.]

(Plates XXI.–XXIII.)

	Page
I. Introductory	530
II. Descriptive	533
Elasmobranchii	533
Holocephala	534
Ganoidei	534
Acipenseridæ	534
Polyodontidæ	536
Amiidæ	537
Lepidosteidæ	540
Polypteridæ	541
Teleostei	544
Physostomi	544
Osteoglossidæ	544
Murænidæ	545
Esocidæ	545
Cyprinidæ	547
Salmonidæ	550
Siluridæ	550
Characinidæ	556
Clupeidæ	557
Gymnotidæ	557
Anacanthini	558
Gadidæ	558
Pleuronectidæ	559
Acanthopterygii	560
Berycidæ	560
Percidæ	564
Sparidæ	566
Scombridæ	567
Carangidæ	569
Sphyrænidæ	569
Cottidæ	571
Mugilidæ	572
Blenniidæ	573
Labridæ	574
Fistulariidæ	576
Cyclopteridæ	577
Trachypteridæ	577
Lophobranchii	578
Syngnathidæ	578
Plectognathi	578
Sclerodermi	578
Gymnodontes	581
III. Summary	584
IV. References	600
V. Explanation of Plates; Reference letters	601

I. INTRODUCTORY.

There seems to be a certain amount of obscurity in the ordinary text-book and other references to the structure and disposition of the supporting skeletal elements of the mesial fins of Ganoid and Teleostean Fishes. These structures are usually referred to as "interspinous bones or cartilages," and as a rule are described as elongated, dagger-shaped bones which at their inner extremities are intercalated between the vertebral neural or hæmal spines, and support distally the series of dermal fin-rays. It seems also to have been tacitly assumed, if not actually so stated, that in most instances each "interspinous" element is a simple unsegmented structure. Thus, Parker [1] in his paper on the skeleton of *Regalecus argenteus*, after referring to the presence of a series

of ovoidal nodules of cartilage in connexion with the distal extremities of the interspinous bones of the mesial fins of this fish, remarks (p. 24):—"I have not met with cartilages of this kind in any fish which has come under my notice, and I can find no account of any such in works at my disposal. I regard them as representing a second or distal series of radials or pterygophores, the interspinous bones forming the proximal series." That Parker was correct in his view of the nature of these cartilages there can be no doubt; and so far as I have been able to discover he appears to have been the first to recognize the existence of bisegmental "interspinous" elements in any Teleost. More recently it has been shown by Ryder [2] and Harrison [3], that in the development of the fins in those Teleosts which they examined each "interspinous" element consists of a proximal division to which is appended a distal nodule of cartilage for the immediate support of a dermal fin-ray, and hence, as in *Regalecus,* such elements are bisegmental. It is, however, by no means difficult to show that these cartilages, or their equivalents in the form of osseous nodules, are very generally present in Teleosts; and further, that in not a few families the intercalation of a hitherto unrecorded * series of mesial ossicles between the proximal and distal segments renders such "interspinous elements" trisegmental.

The main object of the present communication is to describe (*a*) the degree of segmentation and the more characteristic modifications of the "interspinous elements" of the dorsal and anal fins of Teleosts; (*b*) the extent to which such modifications are characteristic of particular groups or families; and (*c*) the various methods by which in different families the segments of the "interspinous" elements contribute to the support of the fin-rays. With these ideas in view a large number of Teleosts were examined, and as far as possible the species selected for examination are typical representatives of the leading subdivisions of the group. Although this paper was originally intended to deal exclusively with Teleosts, it has been thought desirable to include the Ganoids, and also to refer briefly to the Holocephala and Elasmobranchs, in order that an accurate comparison of the fin-supports in these four great groups of Fishes might be made.

The early stages in the development of the mesial fins of

* See reference to Günther's figure of *Beryx decadactylus*, p. 563.

certain Teleosts have been described by Ryder (*l. c.*), and recently in an admirable paper by Harrison (*l. c.*). The observations to be recorded here refer only to adult specimens, and hence may perhaps be regarded in the light of a sequel to the embryological work of these writers.

I have purposely omitted all reference to the supporting skeletal elements of the caudal fins, for the reason that these structures have already received considerable attention at the hands of Kölliker, Huxley, Emery, Lotz, Ryder, and others, to whose researches I have nothing to add.

With regard to the nomenclature to be applied to the so-called "interspinous" bones, and to the segments of which they are composed in different fishes, I must admit that I have experienced some difficulty in the selection of suitable terms. By different writers these structures have been described as "interspinous bones or cartilages," "interspinalia," "fin-bearers," "pterygophores." Ryder (*l. c.*) refers to the distal nodules of cartilage supporting the fin-rays as "actinophores," which, from their relation in the anal or dorsal fins to the hæmal or neural spines of contiguous vertebræ, become interhæmal (hypaxial), or interneural (epaxial) actinophores, the proximal divisions being spoken of as "interspinous elements." Dean [4] designates the two divisions of a bisegmental "interspinous bone" as "radials" and "basals"—the former term applying to the ordinary dagger-shaped interspinous elements, and the latter to the distal cartilaginous nodules or "actinophores" of Ryder *; while Parker (*l. c.*) has suggested the term "pterygophore" as applicable to "any radial or fin-supporting cartilage in either the median or paired fins." It is clearly desirable, in selecting appropriate terms for these structures, that they should be equally applicable to the supporting elements not only of the unpaired dorsal, anal, and caudal fins, but also to the homodynamous structures in the paired pectoral and pelvic fins; and from this point of view such terms as "interspinous bones," or "interspinalia," are obviously unsuitable. "Pterygophore" is a somewhat cumbersome term, especially when it is necessary, as is often the case, to indicate the segments of which a "pterygophore" is composed. "Radials" and "basals" are convenient terms when a fin-support is bisegmental, but scarcely so in the case of trisegmental structures.

* The terms "baseost" and "exonost" have also been suggested (Cope, Am. Nat. 1890, p. 413).

I would suggest, therefore, the use of the term "*radial element*" as the unit of the series of skeletal fin-supporting bones, or cartilages, in both the mesial and paired fins; and in those instances in which such elements undergo segmentation, the terms *proximal*, *mesial*, or *distal segments* may be adopted.

The various species referred to in the descriptive section of this paper are those enumerated by Dr. Günther in the British Museum Catalogue of Fishes (1st ed.), and for this reason the authorities for the specific names have been omitted in the text.

In most instances in the description of the radial elements of different species the number of these elements has been given, but as these structures are liable to some slight individual variation in the same species, the number mentioned must be taken as applying only to the particular specimen examined.

II. DESCRIPTIVE.

ELASMOBRANCHII.

The dorsal and anal fins, but more particularly the dorsal fins, have been so fully and carefully described by Thacker [5] and Mivart [6], that it is unnecessary to do more than direct attention to a few of their results for the sake of comparison with other types. In the majority of the species described and figured by Mivart (*l. c.*) the radial elements are cartilaginous, rod-like structures, generally of fairly uniform thickness throughout their length, and usually divided into proximal, mesial, and distal segments. The individual segments vary in length, and, in different species, each may in turn become the longest. The various radial elements in each fin may afford mutual support to one another, and gain in strength, through their arrangement in close parallel relations throughout their entire length, but occasionally they may separate slightly from one another, either proximally or distally, or even at both extremities. In no instance is there any definite articulation between particular segments of contiguous radial elements. The central, or approximately central, radial elements in either fin are usually the longest, but almost invariably the most anterior and posterior of the series undergo a reduction in length and also lose one or more of their constituent segments.

From this general type of fin-structure the more important deviations in particular genera are brought about by (*a*) the

segments of the radial elements, or of both proximal and mesial; (*b*) the suppression by fusion or atrophy of particular segments, so that more or fewer of the elements become bisegmental instead of trisegmental; and (*c*) the apparently secondary subdivision of the distal segments.

The horny fibres which support the peripheral portions of the fins are several times more numerous than the supporting radial cartilages.

HOLOCEPHALA.

According to Mivart (*l. c.*), the second dorsal fin of *Callorhynchus antarcticus* is supported by a series of forty-one, not quite contiguous, simple and undivided radial elements, of which the anterior are the longest, the remainder gradually decreasing in length from before backwards.

In a skeleton of *Chimæra monstrosa* in the Mason College Zoological Museum there are about one hundred and two similarly simple elements in the relatively much longer posterior dorsal fin of this species. None of the cartilages are in apposition, all being separated to a greater or less extent, while at the same time they are connected and supported by the longitudinal fibrous septum separating the dorso-lateral muscles of opposite sides of the body. As is well-known, the radial elements of the anterior dorsal fin in both genera are greatly modified by concrescence and in other ways, for the support of the powerful spine.

GANOIDEI.

Acipenseridæ.

Acipenser sturio.

As might be expected, the fin-supports of this and the next species are essentially similar to those of the Elasmobranchs, except for their partial ossification.

Dorsal fin.—In *Acipenser* the dorsal fin is supported by a series of sixteen distally distinct radial elements, each of which, with the exception of the first two, consists of three segments, the proximal being the longest, while the distal is reduced to little more than a mere nodule. The first and second have apparently lost their distal segments. The longest radial element is the third, the first and second being somewhat shorter, while those behind the third gradually diminish in length to the two or three most posterior ones, which are by far the shortest of the series.

As a rule each element is of the same thickness throughout its length, or nearly so, and the proximal segments are never dagger-shaped. Concrescence is still evident in the fusion of the proximal segments of the first and second, the eleventh, twelfth, and thirteenth, and those of the fourteenth, fifteenth, and sixteenth, into a single basal segment in each case. The radial elements are but feebly ossified. The first, including the basal segment which it shares with the second, the last two, and the distal segments of all, are wholly cartilaginous, but, with these exceptions, the proximal and mesial segments are partially ossified. In all cases, however, ossification extends only to the formation of a thin crust of superficial bone round an axial core of unaltered cartilage, and leaves the extremities of the segments entirely free from ossific deposit. There is no definite method of articulation between the segments of contiguous elements, although, as in the Elasmobranchs, the latter afford one another mutual support by their parallel disposition, fairly close apposition, and fibrous connexion throughout the greater part of their length.

The characteristic horny fibres of the Elasmobranchs and Holocephala are here replaced by partially ossified, multiarticulate dermal rays, which, as in the higher Ganoids and in Teleosts, are bifurcate proximally and branched distally. The dermal rays still, however, retain traces of the characteristic arrangement of the horny fibres of the preceding groups, in the fact that their cleft proximal extremities embrace not only the distal but to some extent also the mesial segments of their supporting radial elements; and also in their greater number. Altogether there are about forty dermal rays, or approximately about two and a half as many as the radial elements which support them.

Anal fin.—This fin is very similar to the dorsal. There are, however, only ten radial elements, all of which are trisegmental. The second is slightly the longest of the series, those behind gradually decreasing in length from before backwards. The proximal segments of the first and second, and those of the third and fourth, coalesce to form a single basal segment in each case. As far as the particular segments which undergo partial ossification are concerned, the anal differs but little from the dorsal fin, but ossification is somewhat more complete, and to a greater extent replaces the primitive cartilage in the former than in the latter.

About twenty-five dermal rays are supported by the radial elements.

It may be remarked that the precise number of radial elements in the mesial fins and the extent of their concrescence are subject to variation in different individuals. In a much larger specimen (about 8 feet in length) the number of radial elements in the dorsal fin was the same as in the smaller one; but the proximal segments which had fused into single basal pieces were those of the first and second, the third and fourth, and the fifteenth and sixteenth. In the anal fin only the proximal segments of the third and fourth had fused. The figure of the dorsal fin of an *Acipenser* given by Thacker [5], and reproduced by Mivart [6], exhibits only fifteen radial elements, and those represented with fused proximal segments are the first and second, and the eighth and ninth, while the tenth and thirteenth inclusive, in addition to the first, are figured as wanting their distal segments. It is also evident, from a comparison of the two specimens referred to above, that the older the fish the more complete is the extent to which the proximal and mesial segments become ossified, and the less intimately are the various radial elements related to one another.

POLYODONTIDÆ.

Polyodon folium.

The mesial fins of *Polyodon* are, in the main, very similar to those of *Acipenser*, but indications of increasing specialization, and of a gradual approximation to the higher Ganoids, in certain minor points are not wanting.

Dorsal fin.—The dorsal fin is supported by a series of twenty radial elements (Pl. XXI. fig. 1), of which the approximately central ones are the longest, and the most anterior and posterior the shortest. All of them are divided into proximal (*p.s.*), mesial (*m.s.*), and distal (*d.s.*) segments, except the first and the last, which are without distal segments. The proximal segment in each element is about the same length as the mesial, or only slightly exceeds it, and is now somewhat dagger-shaped, with a pointed inner extremity and a much thicker distal portion. The distal segments are mere cartilaginous nodules, forming by their close apposition a well-defined and continuous margin to the periphery of the fin-supports, and also exhibiting a tendency to alternate with the cartilaginous distal ends of the mesial segments. The connexion between the various radial elements is, perhaps, less intimate than in *Acipenser*; only along the centre of the series,

that is at or near the junctions of the proximal and mesial segments, and distally are the elements in actual contact or fairly close relations with one another. Concrescence is less marked and is evident only in the case of the proximal segments of the first and second, and those of the nineteenth and twentieth. With the exception of those belonging to the last radial element, and the mesial segment of the first, all the proximal and mesial segments are fairly well ossified. The inner portions of the proximal segments are entirely osseous, but towards the middle of the length of each segment a slender axial core of cartilage makes its appearance round which the bone forms a thick layer. From the centre outwards the bone gradually thins away, while the core of cartilage thickens and eventually forms the wholly cartilaginous distal extremity of the segment. The mesial segments are, for the most part, solid bone in the centre, but from this point in either direction an axial core of cartilage appears, and the superficial bones gradually thinning away leaves the two extremities of the segment entirely cartilaginous.

From 51 to 53 dermal rays are supported by the twenty radial elements, and, as in *Acipenser*, their deeply cleft proximal extremities embrace the distal, and partially also the mesial segments of the different elements.

Anal fin.—In this fin there are eighteen radial elements, all of which are trisegmental. The only indication of concrescence is the fusion of the proximal segments of the first and second elements. In other respects the anal fin is very similar to the dorsal. The number of dorsal rays is approximately forty-nine.

AMIIDÆ.

Amia calva.

Dorsal fin.—The long dorsal fin of this Ganoid is supported by a series of forty-nine radial elements, all of which are trisegmental with the exception of the first two, the fifth, and the last. The first element is represented only by its proximal segment, which at its distal extremity is tipped with cartilage and supports the first dermal ray. The proximal segment of the second supports a small nodule of cartilage which apparently represents a distal segment. The fifth has no proper proximal segment, and consists only of small cartilaginous mesial and distal segments supported by the proximal segment of the sixth. The forty-ninth, or last of the series of ray-bearing radial elements,

resembles the second *. In all the remaining trisegmental elements (Pl. XXI. fig. 2) the proximal segment (*p.s.*) is a somewhat dagger-shaped bone, slightly broader at its distal extremity where it is tipped with cartilage, but pointed and completely bony at its inner end; and, moreover, presents no trace of the characteristic lateral longitudinal ridges which in most Teleosts separate the elevator and depressor muscles of the fin-rays. The mesial segments (*m.s.*), on the other hand, are short, somewhat hour-glass-shaped bones with cartilaginous extremities, while the distal segments (*d.s.*) are invariably small cartilaginous nodules. The three segments of each complete radial element are in ligamentous connexion with one another, and also with the corresponding segments of contiguous elements.

In one important feature the radial elements of *Amia* differ greatly from those of *Polyodon*, *Acipenser*, and the Elasmobranchs, and resemble the corresponding structures in *Lepidosteus*, and in those Teleosts in which the trisegmental type of radial element exists. The proximal segments are widely separated from one another, and the only connexion between them is the median vertical sheet of fibrous tissue in which they are imbedded; but the mutual relations of the mesial and distal segments are nevertheless such that the various radial elements afford one another mutual support, and two of them contribute to the support of each dermal fin-ray. Thus, each mesial segment is inclined backwards at an angle with the proximal segment and its distal or hinder extremity articulates with, or at all events rests upon, the anterior margin of the distal extremity of the proximal segment of the next succeeding radial element, while each distal segment is in part supported by its own mesial segment and in part by the anterior or upper margin of the mesial segment of the next radial element. Hence, as each distal segment carries a soft fin-ray, it follows that the latter is supported partly by the distal segment of the radial element to which it normally belongs, and partly also, but indirectly, by the mesial segment of the next succeeding element. All the fin-rays are of the soft multiarticulate kind, and each is cleft basally for the reception of the distal segment of a radial element.

The numerical disproportion between the radial elements and

* Immediately behind the forty-ninth, and in close relation with it, there is a vestigial element, consisting of a proximal segment only and without a dermal ray.

the dermal fin-rays, which is so characteristic a feature in the lower types, is altogether wanting in *Amia*. In the latter fish the two are numerically identical, each of the forty-nine radial elements having only a single fin-ray, and this appears to be the typical relation of the two series of structures in all the higher Fishes.

Anal fin.—In the anal fin eleven radial elements support a corresponding number of soft fin-rays. The radial elements are very similar to those of the dorsal fin, both in structure and mutual relations. All are trisegmental except the first two, the first consisting only of a proximal segment, and the second, in addition, of a nodular cartilaginous distal segment. The mesial segments of the third and fourth, and those of the tenth and eleventh, and the distal segments of all the radial elements are cartilaginous.

It would seem that both the anal and dorsal fins are liable to individual variation as regards the precise number of their radial elements. In the specimen described and figured by Franque [7] there were apparently fifty-three elements, including the vestigial rayless one which, as in my specimens, lies immediately behind the last ray-supporting element, and fifty-three dermal fin-rays. The proximal segments of the first and second are figured as if fused together, which was certainly not the case in the specimens I have examined. Shufeldt [8] also mentions fifty-three as the number of radial elements in the specimens he examined. The anal fin is figured by Franque (*l. c.*) as having twelve radial elements, and this seems also to have been the case in Shufeldt's specimens.

It may be remarked that both Franque and Shufeldt overlooked the presence of the distal series of segments in both the anal and dorsal fins. The latter writer, for example, in referring to the fin-rays of the dorsal fin says, "These rays are supported by an equal number of interspinous bones, through the intervention of little ossicles that pass obliquely from one to the other" (*l. c.* p. 85). The "little ossicles" are the mesial segments, the so-called "interspinous bones" being the structures which I have termed proximal segments, but no reference is made to the series of distal segments. Franque (*l. c.*) also makes a similar omission, although he has quite correctly figured the shape and mutual relations of the proximal and mesial segments.

Shufeldt (*l. c.*) figures and describes five "delicate little

bones" which lie behind the radial elements of the dorsal fin and continue the series as far as the caudal fin, and had previously been overlooked by Franque. In one of two specimens I examined four such structures were present and in the other three, in the form of elongated but extremely slender ossicles. As to the nature of these structures, there can be no doubt that they are the persistent proximal segments of a series of vestigial radial elements, and indicate the primitive continuity of the dorsal and caudal fins. The discrepancy in numbers in the different specimens examined is probably due to the well-known variability of such vestigial structures, of which yet another instance may be mentioned. In Shufeldt's figure of these vestiges (*l. c.*, pl. ix. fig. 25) they are represented as without dermal rays, but, curiously enough, in one of my specimens the last two of the series were related distally to two small broadly V-shaped vestigial fin-rays, which were wholly imbedded in the subcutaneous connective tissue; in the second specimen no trace of these structures could be found.

Lepidosteidæ.

Lepidosteus osseus.

Dorsal fin.—In this Ganoid the dorsal fin is situated immediately anterior to the anal fin, and consists of eight radial elements (Pl. XXI. fig. 3), supporting eleven soft dermal fin-rays. The 2nd to the 8th inclusive are trisegmental, and in shape and in their relations to one another and to those of contiguous elements the different segments closely resemble those of *Amia*. The mesial segments, like the proximal, are all well ossified, with the exception of that belonging to the second radial element, which, as is also the case with all the distal segments, is cartilaginous. The first radial element ($r.e.^1$) has a much larger proximal segment than any of the others, and the simple elongated nodule of cartilage which is attached to its distal extremity apparently represents a distal segment. Of the eleven fin-rays, the first three are supported by the distal segments of the first radial element, and the tenth and eleventh by the corresponding segment of the last element. The remaining fin-rays are each supported by a distal segment, precisely as in *Amia*.

The fact that the proximal segment of the first radial element is larger than any of the other proximal segments, and is related to three dermal rays, suggests the possibility of the fusion of certain of the anterior supporting elements of the fin.

The segment itself, however, exhibits no indication that its size is due to the union of originally distinct elements; and I am inclined to think that the fact that it happens to support two rays in addition to the one, viz. the third, which properly belongs to it, is simply due to the concentration of certain of the anterior fin-rays, which have apparently lost their radial elements during the partial atrophy of a primitively more extensive fin. Similar instances of this concentration of fin-rays, and the support of two or more of them by a single radial element, are to be noted in the last radial element of the dorsal fin of *Lepidosteus* and in the first and last of a large number of Teleosts.

Anal fin.—The anal fin lies immediately beneath the dorsal fin, and consists of nine radial elements and thirteen fin-rays. All the radial elements, including the first, are precisely similar to the corresponding structures in the dorsal fin, but the last, as well as the first, supports three fin-rays.

POLYPTERIDÆ.

Polypterus bichir.

Dorsal fin.—The anterior section of the dorsal fin is composed of fourteen * more or less distinct finlets, each of which consists of a stout spine and a posterior membranous portion supported by four soft multiarticulate rays which are attached by their proximal extremities to the upper half of the posterior margin of the spine. The more posterior finlets exhibit a tendency to fuse with one another through the gradual extension backwards of the membranous portion and its attachment to the basal portion of the spine of the succeeding finlet. The last spine, that is the fourteenth, is united by the membranous part of its finlet to the first of a series of eight stout, similarly united, slightly branched and multiarticulate fin-rays, which form the posterior section of the dorsal fin. The latter fringe the dorsal margin of the terminal portion of the tail, and are continuous behind with the similarly constituted infra-caudal rays. The fourteen finlet-spines

* The number of finlets, and consequently also the number of radial elements, is liable to individual variation (*cf.* Günther, Brit. Mus. Cat. of Fishes, vol. viii. pp. 327 & 517): hence the figures given above must be taken to apply only to the particular specimen examined, which was 15 inches in length. It is interesting to note that a somewhat similar individual variation has recently been recorded for the Notacanthid Teleosteans (Goode & Bean, Proc. U. S. Nat. Mus. vol. xvii. pp. 456–470).

(Pl. XXI. fig. 4, *sp.r.*) are supported by an equal number of simple, laterally-compressed, unsegmented, and widely separated radial elements (*r.e.*). The latter are somewhat slender, and the slightly thickened upper or distal extremity of each is tipped with cartilage and forms a globose condyle, which fits into a suitable socket in the expanded base of its finlet-spine. The radial elements supporting the multiarticulate posterior series of fin-rays (fig. 5) are similar to those supporting the finlets, except for their greater length and more cylindrical shape. They are also more concentrated, and, instead of articulating with their rays by a ball-and-socket joint, the cleft base of each ray simply embraces the cartilage-tipped distal end of its supporting radial element. Most of the anterior radial elements are very obliquely disposed, their inner extremities being directed forwards and only to a slight extent downwards, so that practically the arrangement of these elements is nearly horizontal. More posteriorly, where the finlets become replaced by a continuous dorsal fin, the radial elements gradually become less horizontal, and, while still remaining obliquely disposed, approximate more to the vertical and interdigitate with the neural spines of the subjacent vertebræ. All the radial elements are embedded in the median vertical fibrous septum separating the dorso-lateral musculature of opposite sides of the body, and by it are connected with one another.

Thin, somewhat triangular, cartilaginous laminæ (fig. 5, *x*) are attached to the posterior margins of more or fewer of the radial elements, near their outer or distal extremities. These laminæ first make their appearance on the ninth, and gradually increase in size to the fifteenth. From the fifteenth to the twenty-first they diminish in size and finally disappear, the last one or two elements exhibiting no trace of them. In the twelfth to the fourteenth elements, inclusive, the laminæ become more or less completely ossified. Whether osseous or cartilaginous, the laminæ project backwards from the various radial elements with which they are in ligamentous connexion into the fibrous septum separating the dorso-lateral musculatures. These structures can scarcely belong to the category of radial elements, and are probably mere chondrifications of the intermuscular septum, developed for the purpose of strengthening the points of origin of the powerful erector muscles of the spines and fin-rays. At any rate the erectores of each spine or fin-ray take origin not

only from the anterior surface of its supporting radial element, but also from opposite sides of the intermuscular septum in which the lamina of the next anterior element is developed, and thence run obliquely backwards to their insertion into the base of the spine or fin-ray as the case may be *.

It may be mentioned that Mivart [6] seems to have entirely misunderstood the nature of the fin-supports of *Polypterus*. In his description of the dorsal fin he says :—" This fin is supported by radials which give off on one side small secondary rays proceeding dorsad and postaxiad " (*l. c.* p. 458 ; also pl. lxxix. fig. 6). It is clear from the use of the term " radials," as well as from the accompanying figure, that Mivart is here describing the spines and soft rays of the series of finlets, and has entirely overlooked the true "radials," which are situated beneath and support the finlets. It is probable that this usually accurate morphologist only had access to an imperfectly prepared skeleton.

Anal fin.—The anal fin of *Polypterus* consists of six radial elements (fig. 6), of which the first (*r.e.*[1]) is a simple bony rod, slightly thickened and tipped with cartilage at its ventral end. The remainder are bisegmental, each consisting of a ventral segment (*v.st.*) similar to the simple segment of the first, and a slender styliform dorsal segment (*d.st.*). The segments of all the elements are well ossified, with the exception of the dorsal segment of the last one, which is cartilaginous. The distal extremities of the ventral segments are in close contact with one another so as to form a continuous, even if somewhat irregular, peripheral margin. The first five radial elements are situated in front of the first complete hæmal arch (*h.s.*), to the spine of which the sixth is attached by ligament.

Thirteen soft multiarticulate and slightly branched fin-rays are supported by the six radial elements, the ventral segments of the latter being embraced for a third of their length by the cleft rays. Each element, however, obviously contributes to the support of at least two fin-rays.

In older and larger specimens than that described above, the ventral divisions of the different radial elements are not merely larger and relatively more expanded towards their distal extremities, but the three anterior ones, which are longer than

* Ryder (2. Pl. v, fig. 2) gives a figure, "from Agassiz's 'Poissons Fossiles,' modified after Kölliker," in which these structures are described as " non-ray-bearing interspinous epural elements."

the others, are partially confluent proximally and distally, although separated centrally by large oval or elongated vacuities. The fin-supports of a specimen of this character are represented in a figure by Mivart (*l. c.* pl. lxxix. fig. 8), which is perfectly accurate so far as the ventral segments are concerned, although, curiously enough, the dorsal segments of the radial elements are neither represented in the figure nor referred to in the text.

TELEOSTEI.

PHYSOSTOMI.

OSTEOGLOSSIDÆ.

Osteoglossum formosum.

Dorsal fin.—In a skeleton of this species in the Mason College Zoological Museum there are eighteen soft fin-rays and nineteen * radial elements in the dorsal fin. The penultimate radial element consists of a proximal and a distal segment, the latter supporting a fin-ray; the last has only a proximal segment, and is also without a fin-ray. All the remaining elements (Pl. XXI. fig. 7), including the first, are trisegmental, and each consists of a long and somewhat dagger-shaped slender proximal segment (*p.s.*); a much shorter, slender, and slightly hour-glass-shaped mesial segment (*m.s.*); and a rounded, nodular distal segment (*d.s.*). All the segments are completely ossified. The proximal segments exhibit no trace of the strong lateral longitudinal ridges which in most Teleosts separate the erector and depressor muscles of the fin-rays while providing surfaces for their origin. The articular interconnexions of the various radial elements for mutual support are very similar to those of *Amia* and *Lepidosteus*. The slightly enlarged distal extremity of each proximal segment is divided into an anterior and a posterior facet. The posterior facet articulates with the mesial segment, which is directed obliquely backwards and upwards, and in turn articulates with the distal segment, but the latter is also supported by the anterior facet of the proximal segment of the next succeeding radial element.

With the exception of the last, all the radial elements support fin-rays. The cleft proximal end of each ray (*f.r.*) embraces the distal segment of its proper supporting radial element, but from what has been said as to the articular relations of each

* Exclusive of a slender splint-like bone which is situated immediately anterior to the first of the fin-bearing series, and is apparently a vestigial radial element.

distal segment it is clear that two elements contribute to the support of each ray.

Anal fin.—The anal fin (fig. 8) is a facsimile of the dorsal fin except for an increase in the number of radial elements and fin-rays, there being twenty-six of the former and twenty-five of the latter.

Murænidæ.

Conger conger.

Dorsal fin.—The extensive dorsal fin of this species resembles that of *Osteoglossum*, and is equally primitive. All the radial elements (Pl. XXI. fig. 9) are similar in character, and all are trisegmental. The mesial segments (*m.s.*) are well developed, and although firmly united at one extremity to the proximal segments (*p.s.*), are nevertheless separated from the latter by well-marked sutures. The relations and articulations of the various segments of a radial element to one another and to those of contiguous elements for mutual support are much the same as in *Osteoglossum*.

As in *Amia* and *Lepidosteus*, and as in most other Teleosts with trisegmental radial elements, an interossicular ligament (fig. 9, *int. lig.*) extends between and connects together the distal and mesial segments of successive radial elements.

The fin-rays, as usual, are bifid at the base for the purpose of clipping the distal radial segments by which they are supported. Each of the basal arms of a fin-ray (fig. 10 *f.r.*) is provided with a peg-like projection or tubercle on its inner surface, and the two tubercles of each ray fit into shallow pits or sockets on the lateral surfaces of the distal segment (fig. 10, *d.s.*; also fig. 9). This method of connexion between fin-rays and the distal segments of their supporting radial elements will in future be referred to as a "peg-and-socket" articulation.

Anal fin.—The radial elements are precisely similar to those of the dorsal fin.

Anguilla anguilla.

In so far as the fin-supports are concerned, this species closely resembles the preceding.

Esocidæ.

Esox lucius.

Dorsal fin.—This fin consists of about twenty-one soft fin-rays, supported by twenty radial elements (Pl. XXI. fig. 11). The

first radial element ($r.e.^1$) consists only of a bony proximal segment which has the usual dagger-like shape, and, in addition to being slightly expanded, is tipped with a pad of cartilage at its distal extremity. In the second ($r.e.^2$) the cartilaginous distal portion of the segment becomes slightly elongated upwards and backwards, and a distal segment is added. In the third and succeeding elements as far as the seventeenth, the distal cartilaginous epiphyses of the proximal segments (*p.s.*) gradually assume the proportions and relations of true mesial segments. In the sixth element ($r.e.^6$) an ossific centre makes its appearance in the epiphyses, and, gradually enlarging in the succeeding elements, becomes in the eighth to the twelfth inclusive ($r.e.^8$–$r.e.^{12}$) a fairly well-developed hour-glass-shaped mesial segment (*m.s.*). From the twelfth to the fifteenth the ossified mesial segment becomes gradually smaller and finally disappears. Posterior to the seventeenth element the cartilaginous epiphyses of the remaining proximal segments fuse into a continuous strip of cartilage supporting dorsally the corresponding distal segments. All the radial elements, except the first, possess distal segments (*d.s.*), which from the fourth to the fifteenth are more or less completely ossified, but remain simple cartilaginous nodules in front of the fourth and posterior to the fifteenth. The relations of the distal segments to the mesial segments, and to the proximal segments of contiguous elements, are precisely the same as in *Osteoglossum*.

It is obvious, therefore, that the central radial elements of the dorsal fin of *Esox*—that is from the sixth to the fifteenth inclusive—are typically trisegmental, and that anterior and posterior to these the elements become bisegmental or unisegmental according as a distal segment is, or is not, present.

All the proximal segments, except those pertaining to the first two and the last five radial elements, have each of their lateral surfaces traversed by a more or less well-marked longitudinal ridge, which separates the elevator and depressor muscles of each fin-ray and serves for the partial origin of both.

Of the twenty-one fin-rays the third, like those succeeding it, is supported by the distal segment of its proper radial element (viz., the third), which is, as it were, clipped by the cleft base of the ray. The two anterior rays simply rest basally on the thickened cartilaginous extremities of the proximal segments of the first and second radial elements.

In a second specimen examined, twenty-two fin-rays were present, the first three in this case being supported by the proximal segments of the first two radial elements.

Anal fin.—This fin very closely resembles the dorsal fin. There are fewer radial elements and fin-rays, viz., eighteen and twenty respectively, but all the central fin-supports are trisegmental.

CYPRINIDÆ.

Barbus vulgaris.

Dorsal fin.—In this Cyprinoid the dorsal fin consists of twelve fin-rays, supported by ten radial elements (Pl. XXI. fig. 12). Of the latter the fifth to the ninth (*r.e.*^{5}–*r.e.*^{9}) inclusive are the most complete, each consisting of proximal (*p.s.*), mesial (*m.s.*), and distal (*d.s.*) segments. Each proximal segment is a relatively large and somewhat dagger-shaped bone, which for a variable portion of its length articulates by its straight and almost parallel anterior and posterior margins with the corresponding edges of the proximal segments in front and behind, and is traversed on each of its lateral surfaces by a prominent longitudinal ridge. The distal end of the segment is greatly thickened, and provided anteriorly with three facets, one median and two lateral, and posteriorly with a fourth articular surface. The mesial segments are short thick ossicles, suturally united at one extremity to the posterior facet on the distal end of the corresponding proximal segment, and with the usual oblique inclination backwards to its articulation with the somewhat quadrate and much smaller distal segment. The distal segment, as well as the contiguous margin of the mesial segment, rest inferiorly on the median facet of the next succeeding proximal segment. The first to the fourth radial elements (*r.e.*^{1}–*r.e.*^{4}) inclusive lack separable mesial segments, but possess instead, at first a facet, and ultimately an upwardly and backwardly directed postero-superior process with a terminal articular surface for the distal segment. The tenth or last (*v.e.*) is a vestigial element, being represented by a proximal segment only.

Of the twelve fin-rays, the first four are spines of variable length, decreasing in size from behind forwards; the remainder are soft multiarticulate rays. The first three spines are carried by the laterally expanded distal end of the proximal segment of the first radial element. The fourth, or large defensive spine

(*d.s.*), is the proper fin-ray of the first radial element, but although its bifid base clips the distal segment of that element, it is mainly supported by the two laterally-placed facets on the hinder margin of the distal extremity of the second proximal segment. The twelfth fin-ray mainly is supported by the distal segment of the ninth radial element (*r.e.*^{9}). All the remaining fin-rays are supported by a corresponding number of radial elements, viz., by the second to the eighth inclusive. In most instances not only does the cleft base of the fin-ray clip the distal segment of its radial element but, in addition, articulates by two basal condyles with the two facets on the anterior margin of the distal end of the proximal segment of the next succeeding element.

As in some other Cyprinoids, there are two or three vestigial radial elements which are represented only by proximal segments in the form of small, thin, and somewhat irregularly shaped laminæ of bone, and are situated immediately anterior to the first ray-bearing element. The vestigial elements undoubtedly indicate the existence of a primitively longer dorsal fin than is present in the adult, and it is quite possible that they may represent the original fin-supports of those additional fin-rays which are supported by the first of the normal series of radial elements.

Anal fin.—This fin consists of seven radial elements and nine fin-rays, and, on the whole, is very similar to the dorsal fin (Pl. XXI. fig. 13). In the series of radial elements, the presence of a distinct mesial segment in addition to proximal and distal segments is restricted to the fourth, fifth, and sixth. In front of the fourth the elements are bisegmental, while the seventh has only a proximal segment. The first element supports two fin-rays in addition to partially supporting the third, which is its proper ray. The fin-ray of the last radial element is firmly attached to its predecessor, and is really supported by the distal segment of the penultimate element. All the remaining fin-rays are supported precisely as in the dorsal fin.

Cyprinus carpio.

Dorsal fin.—Except for its greater length and the consequent increase in the number of radial elements and fin-rays, which are twenty-two and twenty-five respectively, the dorsal fin of the Carp closely resembles that of the Barbel. The trisegmental radial elements are the third to the twenty-first inclusive, the

first and second having only proximal and distal segments, and the last a proximal segment. It is, perhaps, worth remarking that the distal segments of more or fewer of the anterior elements apparently ossify from two distinct lateral centres, which entirely replace the primitive cartilage but nevertheless leave a persistent longitudinal suture.

The fourth fin-ray, the defensive spine, is the ray which rightly belongs to the first radial element, although, as in *Barbus*, it is mainly supported by the two laterally situated facets on the adjacent extremity of the proximal segment of the second. The three short anterior fin-spines, also as in *Barbus*, are supported by the distal end of the proximal segment of the first radial element.

The articular relations of the segments of the same radial element to one another and to those of contiguous elements, as well as the relations of the fin-rays to both, are much the same as in the preceding species.

Anal fin.—In all essentials this fin resembles the dorsal fin. There are seven radial elements and nine fin-rays. Of the former three, viz., the fourth, fifth, and sixth, are trisegmental, those anterior to them being bisegmental, while the seventh has only a proximal segment. The serrated defensive spine is the third of the series of fin-rays, and, as in the dorsal fin, is the one pertaining to the first radial element.

Abramis brama.

Tinca tinca.

Both the Bream and the Tench are very similar to the preceding Cyprinoids in the character of their radial skeletal elements. In both the dorsal and anal fins all, except the most anterior and posterior, are trisegmental, the remainder being bisegmental or unisegmental.

The Bream is remarkable for possessing a series of about eight well-developed lamellar ossicles which are situated immediately anterior to the normal ray-bearing radial elements of the dorsal fin, and lie between the neural spines of the subjacent vertebræ. These ossicles are the proximal segments of the fin-supports of the atrophied anterior section of the dorsal fin.

SALMONIDÆ.

Coregonus pollan.

Dorsal fin.—In the rayed dorsal fin there are twelve radial elements, supporting thirteen fin-rays. Of the radial elements, six, viz. the sixth to the eleventh inclusive, are trisegmental. The suture between the mesial and proximal segments is occasionally somewhat difficult to detect, but sections taken through the line of junction readily prove its existence. The first two elements and the last consist of proximal segments only, and the third, fourth, and fifth of a distal segment in addition.

The first radial element supports two fin-rays, of which the second rightly belongs to that element. All the remaining elements are each related to a single ray, although, as in the preceding Teleosts, two elements contribute, directly or indirectly, to the support of each.

A series of fifteen slender bones is situated in front of the first of the ray-bearing radial elements, imbedded in the median fibrous sheet separating the dorso-lateral muscles of opposite sides of the body, and agreeing in number with the subjacent vertebræ. Anteriorly to these, and continuing the series to the posterior face of the skull, there are two thin lamelliform bony plates, of which the anterior is much the larger. The seventeen slender or lamelliform ossicles are the proximal elements of a series of vestigial radial elements, and may be taken as an indication of a primitive extension of the dorsal fin as far forwards as the head.

Anal fin.—Eleven radial elements and thirteen fin-rays are present. The third to the eleventh of the radial series inclusive are trisegmental, the first and last unisegmental, and the second bisegmental.

The third fin-ray is the one belonging to the first radial element, which therefore supports two rays in addition to its own proper ray.

SILURIDÆ.

Platystoma tigrinum.

Dorsal fin.—With the exception of certain minor differences, the dorsal fin of this Siluroid resembles that of *Amiurus catus* which has been described by McMurrich [9]. There are eight distinct radial elements and a corresponding number of fin-rays (Pl. XXI. fig. 14). The five posterior radial elements are fairly similar,

and each consists of a proximal (*p.s.*) and a distal (*d.s.*) segment. Each proximal segment is broad above, but becomes slender and tapering towards its inner extremity. For the upper half of its extent the segment suturally articulates with its fellows in front and behind by straight or slightly curved anterior and posterior margins, while the distal extremity is somewhat expanded laterally and, at the same time, produced obliquely upwards and backwards into an abruptly truncated "postero-superior" process (*ps.p.*) which articulates with the distal segment, and almost precisely resembles a confluent mesial segment both in its relations to the distal segment and in its mode of articulation with the antero-superior margin of the next succeeding proximal segment. The postero-superior process and the adjacent anterior portion of the distal end of the segment furnish a smooth concave surface for articulation with the base of a fin-ray. The distal extremity of the proximal segment of the last radial element is produced backwards into a thick lamina of bone, which may possibly represent one or more fused segments.

The distal segments are simple osseous nodules. Interossicular ligaments extend from the upper surface of the postero-superior process of each proximal segment to the distal segment, and from the latter to the postero-superior process of the next succeeding proximal segment.

The first three radial elements (*r.e.*^{1}–*r.e.*^{3}) differ somewhat from the others. They are more or less firmly united together by suture throughout their entire length, and are otherwise modified for the support of the large defensive spine and the smaller spine in front of it—the "guard-spine"—which provides for the support and fixation of the defensive spine in the erect position. The first (*r.e.*^{1}) includes only a proximal segment (*p.s.*), and is represented by a somewhat triangular bony plate with the apex directed forwards and its base firmly attached by suture to the proximal segment of the second. Distally, the plate is produced outwards into two prominent lateral ridges. The second also consists only of a proximal segment (*r.e.*^{1}, *p.s.*) similar in shape to those which succeed it, but terminating distally in a projecting process (*p.*), provided with a smooth anterior surface, for the support of the "guard-spine" (*g.sp.*). Distally also, but at a point anterior to the projecting process already mentioned, the lateral margins of the segment are produced outwards and backwards in such a way as to form a horizontally disposed V-shaped

lamina of bone (Pl. XXI. fig. 15, *r.e.*^{2}, *p.s.*), in the angle of which is situated the "guard-spine," while the apex is suturally articulated with the produced lateral margins of the first proximal segment (*r.e.*^{1}, *p s.*). The third radial element (fig. 14, *r.e.*^{3}) is more normal, and consists of a proximal segment (*p.s.*) with a postero-superior process and an ossified cubical distal segment (*d.s.*) embraced by the cleft base of the third fin-ray. The proximal segment, like those of the preceding radial elements, has the lateral margins of its distal extremity produced outwards in the form of wing-like laminæ (fig. 15, *r.e.*^{3}, *p.s.*), which, superiorly, form a transversely elongated surface for the support of the defensive spine (fig. 14, *d.sp.*), and at either extremity suturally articulate with the hinder ends of the V-shaped lamina of the second proximal segment (fig. 15). The arrangement of the foramina for the transmission of the erector muscles of the guard and defensive spines is very similar to that described by McMurrich in the case of *Amiurus catus*. In a dorsal view (fig. 15) it will be seen that the V-shaped lamina, in conjunction with the lateral wings of the third proximal segment, encloses a somewhat triangular space in which are situated the bases of the two spines and their supports. The large foramen on each side of these structures (f^2) transmits the erector muscles of the defensive spine, the corresponding muscles of the "guard-spine" passing from their origin to their insertion through two much smaller lateral foramina (f^1) which perforate the distal end of the second proximal segment immediately beneath the V-shaped lamina.

There are eight fin-rays, which in order from before backwards include (i.) the "guard-spine," (ii.) the large defensive spine, and (iii.) a series of six soft multiarticulate rays. The third to the eighth inclusive, that is the six soft rays, are perfectly normal in their mode of support and in their relations to the last six of the radial series. Each ray (fig. 14) is supported partly by the distal segment of its proper radial element and partly also—and this is more particularly the case with the third, fourth, and sixth rays—by the articulation of its bifid condylar base with the distal extremity of the next succeeding proximal segment. The guard and defensive spines, however, are somewhat peculiar. The defensive spine, instead of being bifid, has a transversely elongated base, divided into a median and two lateral condyles, and apparently formed by the secondary fusion of the basal extremities of an ordinary cleft ray. The lateral condyles articulate with

the lateral wings at the distal end of the third proximal segment, immediately anterior to the origin of its postero-superior process, while the median condyle fits into a mesial pit. Above the three condyles, the base of the spine is perforated by an oval foramen through which is prolonged a curious hook-shaped process (*h*) developed from the anterior or dorsal surface of the postero-superior process, and from the extremity of the hook a stout ligament extends to an insertion into the distal end of the second proximal segment. This hook probably owes its formation to the partial ossification of the strong interossicular ligament which, in the absence of distal segments, passes between the distal extremities of the proximal segments of the first two radial elements, and in other Siluroids, where the ligament is completely ossified, gives rise to the characteristic "chain-link" articulation of the defensive spine with its supporting radial element. As the third radial element is already provided with a fin-ray, viz. the first soft ray, the defensive spine must be regarded as the ray normally pertaining to the second element. The "guard-spine" is a simple, short, V-shaped ossicle and, although supported by the second radial element, is really the fin-ray of the first.

This view of the relations of the anterior fin-rays to their supporting radial elements differs from that given by McMurrich in the case of *Amiurus* in one or two particulars. According to this writer the radial element of the defensive spine is the third, that of the "guard-spine" being the second, while the fin-ray of the first element is represented by the V-shaped lamina. The reason assigned for the last suggestion is—that what corresponds to the V-shaped lamina in *Amiurus* is an ossification in membrane, and ought therefore to be regarded as belonging to the category of fin-rays, inasmuch as the radial elements are always preformed in cartilage. In my opinion this reason is scarcely a conclusive one. The lateral wings of the third proximal segment in *Platystoma* are almost certainly formed of membrane-bone, and the same is in all probability true of the produced lateral margins of the first; but these facts alone are quite insufficient to justify one in regarding such outgrowths as degenerate fin-rays. Moreover, it is admitted by McMurrich that portions of the first and third "interspinalia" in *Amiurus* are formed of membrane-bone, and yet it is not suggested that such portions represent fin-rays. It seems more reasonable to infer that the partial ossification of certain proximal segments from membrane is the result

of the expansion of their distal extremities for the support of the modified defensive and guard spines. It may further be pointed out that, if the relations of the various radial elements to the series of fin-rays be traced from behind forwards, no special difficulty with regard to the mutual relations of the more anterior of them need be experienced. It is only necessary to bear in mind (i.) that in the normal portion of the fin each fin-ray is supported by two contiguous radial elements, although it is to the anterior of the two that the ray rightly belongs; and (ii.) that in the anterior portion of the fin the loss of the distal segments of their proper radial elements has led to the backward displacement of certain of the fin-rays (that is, the guard and defensive spines), and also to their exclusive support by the proximal segments of the radial elements immediately posterior to those to which they really belong. In the light of these considerations, it is an easy matter in the case of *Platystoma* to correlate the eight radial elements with the eight fin-rays in the order of their sequence from before backwards.

Anal fin.—In the anal fin there are thirteen radial elements and sixteen fin-rays. The fourth to the thirteenth radial elements (fig. 16) inclusive are composed of both proximal (*p.s.*) and distal (*d.s.*) segments, but without any trace of separable mesial segments. Each proximal segment is produced downward and backward into a postero-inferior process (*pi.p*), precisely analogous to the postero-superior processes of the dorsal fin, and, like the latter, having the appearance and relations of a confluent mesial segment. Each of the first three radial elements consists of a proximal segment only, which has no trace of the postero-inferior process of the succeeding segments. Concentration of the fin-rays is apparent at each extremity of the series. The last radial element supports two rays, while the first three support between them the first five fin-rays, of which the third is the normal ray of the first radial element. All the fin-rays have cleft bases and, with the exception of the first five, their mode of support is similar to that of the central and posterior rays of the dorsal fin. In the absence of distal segments, the first five rays are supported by the three anterior proximal segments.

Amiurus catus.

Dorsal fin.—This fin is very similar to the corresponding fin in the preceding species, and for an account of its structure and

development reference may be made to McMurrich's description of the osteology of *Amiurus* (l. c.).

Anal fin.—The anal fin is also very similar to that of *Platystoma* except for the greater number of radial elements and fin-rays, which in the specimen examined were twenty-one and twenty-two respectively.

Cnidoglanis megastoma.

In this Siluroid there are two dorsal fins, an anterior situated immediately behind the head, and a long posterior which is co-extensive with the caudal section of the trunk and continuous posteriorly with the caudal fin.

Anterior dorsal fin.—This fin is very similar to the dorsal fin of *Amiurus* and *Platystoma*, except that there are but six radial elements and seven fin-rays. The first three radial elements are precisely similar to those of *Platystoma*, both in structure and in their relations to the guard and defensive spines, the reduction in the number of radial elements being at the expense of the hinder of the series. The distal segment of the last radial element supports two dermal rays.

Posterior dorsal fin.—The posterior section of the dorsal fin is supported by a series of slender fin-rays, all of which are deeply cleft proximally and slightly branched distally. The proximal ends of the rays are pointed, and penetrate between the neural spines of the subjacent vertebræ into the median fibrous septum which separates the dorsal muscles of the trunk. Proximally also the rays are in ligamentous connexion with one another and with the extremities of the neural spines. There is no trace of radial elements in any part of the fin. With the possible exception of a few other Siluroids, the presence of fin-rays without supporting radial elements is a condition which is unique among Teleostean Fishes; and I am inclined to regard the total suppression of such elements as a transitional stage in the degeneration of the posterior dorsal fin to a vestigial adipose fin.

Anal fin.—In external appearance the anal fin is extremely similar to the posterior dorsal fin, but structurally the two are very different. A complete series of radial elements is present, in number about sixty-three or sixty-four, and, with the exception of the first, all are bisegmental, consisting of slender, distally expanded proximal segments and small nodular distal segments. The fin-rays and their mode of support are also perfectly normal.

There are indications of the concentration of fin-rays at the anterior end of the fin in the presence of two rays in excess of the number of radial elements.

CHARACINIDÆ.

Citharinus Geoffroyi.

Dorsal fin.—There are sixteen radial elements supporting nineteen dermal fin-rays. The radial elements (Pl. XXI. fig. 17) are all bisegmental, consisting of proximal (*p.s*) and distal (*d.s.*) segments, with no trace of mesial segments or of the postero-superior processes which so often take their place. The distal segments are somewhat interesting inasmuch as they illustrate a further stage in the gradual conversion of the segment into the hook-shaped distal segment of many Acanthopterygian Teleosts. The distal segment of the first radial element (*r.e.*[1], *d.s.*) is larger than any of the others, and in the form of an elongated and somewhat quadrate ossicle articulates with the distal end of its proximal segment (*p.s.*), and also partially overlaps the corresponding extremity of the next proximal segment and suturally articulates with its distal segment. The remaining distal segments are somewhat smaller, and many of them exhibit traces of a median longitudinal suture, but all of them have similar relations to their own and succeeding proximal segments as well as to contiguous distal segments. Excluding the first, each distal segment has on its lateral surfaces, near the anterior end of the segment, a concavity so deep that the two nearly meet in the centre of the segment (fig. 17). These concavities or sockets are for the reception of the condylar projections from the inner surfaces of the cleft basal end of a fin-ray (see dorsal view, fig. 18), and hence the mode of articulation of the two structures assumes a further extension of the "peg-and-socket" joint already indicated in the case of *Conger*. A slight extension of this modification in the direction of extending the inward growth of the two condylar projections of the fin-ray so that they meet and fuse, while at the same time the posterior end of each distal segment becomes contracted and curved into a hook, and the characteristic "chain-link" articulation of so many Acanthopterygii is easily reached. The distal segment of the first radial element differs from the rest in having three pairs of lateral sockets, the last pair, however, being in part formed by the hinder portion of

the corresponding segment of the second radial element. The first radial element is related to four fin-rays, of which the first three are but feebly developed. The first ray simply rests on the anterior margin of the distal end of the proximal segment; but the second, third, and fourth, the last mentioned being the ray strictly belonging to the first radial element, articulate with the three pairs of sockets on the distal segment.

Anterior to the first ray-supporting radial element there are seven flattened lamellar bones extending forwards nearly to the supraoccipital spine, and apparently representing a series of vestigial proximal radial segments which have lost their fin-rays.

Anal fin.—This fin in all essentials very closely resembles the dorsal fin, except for the larger number of radial elements (viz., twenty-five) and fin-rays (viz., twenty-eight). This distal segment of the first radial element is, however, apparently double.

CLUPEIDÆ.

Clupea harengus.

Dorsal fin.—In this species the eighteen fin-rays of the dorsal fin are supported by a corresponding number of radial elements. All the radial elements are very similar, and each consists of a proximal and a distal segment, the former having a well-marked postero-superior process. No distinct mesial segments could be detected. The nodular distal segments are simply clipped by the cleft bases of the various dermal rays. In front of the first ray-bearing radial element there is a series of about eighteen slender vestigial proximal segments extending forwards at regular intervals to the skull.

Anal fin.—There are fifteen radial elements, all of which are very similar to those of the dorsal fin, and seventeen fin-rays. The first radial element supports two fin-rays, of which the second clips the distal segment. The last radial element is also related to two fin-rays supported by its distal segment.

GYMNOTIDÆ.

Gymnotus electricus.

The dorsal fin is entirely absent.

Anal fin.—The long anal fin of this species is supported by an equally extensive series of radial elements. The latter (Pl. XXII.

fig. 19) consist of long, slender, rod-like proximal segments (*p.s.*), each of which is slightly expanded and tipped with cartilage at its distal end. There is no trace of mesial segments, or of postero-superior processes to the proximal segments, and a series of fibrous pads, interposed between the proximal segments and the fin-rays, are all that represent the osseous or cartilaginous distal segments of other Fishes. The radial elements have no articular connexion with one another, and, except for a continuous ligamentous connexion between the distal extremities of their proximal segments, are quite distinct.

The fin-rays (*f.r*) correspond in number with their supporting radial elements, and each is supported solely by a single element. Their cleft basal extremities, which have irregular dentate edges instead of smooth articular surfaces as in most other Teleosts, embrace between them the fibrous representatives of the distal radial segments.

ANACANTHINI.

GADIDÆ.

Gadus æglefinus.

In this Gadoid there are three dorsal fins—an anterior, a mesial, and a posterior, separated from one another by short but distinct intervals. The anal fin is also divided into similarly separated anterior and posterior divisions.

Anterior dorsal fin.—Sixteen radial elements form the supporting skeleton of this section of the dorsal fin. All but the last consist of a large well-ossified proximal segment with a well-developed postero-superior process, and a small, cartilaginous, nodular distal segment, which is embraced by the cleft base of its dermal fin-ray. The last of the series consists of a small proximal segment only, without a distal segment or a fin-ray.

Mesial dorsal fin.—This fin is very similar to the anterior dorsal but includes nineteen radial elements, each, including the last, consisting of proximal and distal segments and supporting a fin-ray.

Posterior dorsal fin.—The posterior division of the dorsal fin very closely resembles the mesial section. There are, however, twenty radial elements and a corresponding number of fin-rays.

It may be noted that in each section of the dorsal fin the fin-

supports gradually diminish in size from before backwards, and the same may be said of the three sections collectively.

Three vestigial radial elements, without distal segments or fin-rays, are interposed between the mesial and porterior dorsal fins. It may in fact be said that, so far as their radial elements are concerned, these fins form a continuous structure, the interval between them which is apparent externally being simply due to the suppression of the three fin-rays corresponding to the three vestigial radial elements.

No vestigial elements between the anterior and mesial dorsal fins could be detected.

Anterior anal fin.—This section of the anal fin consists of twenty-five radial elements and twenty-six fin-rays. Of the former, all but the last are bisegmental, and in other respects are very similar to the corresponding structures of the dorsal fin. The last of the series is much smaller than the rest, almost horizontal in position, and, in the absence of a distal segment, its cartilaginous extremity supports a feebly developed ray. In addition to its own proper ray, the second of the series, the first radial element supports a feeble ray in front of the former.

Posterior anal fin.—In this fin there are twenty radial elements and an equal number of fin-rays. All but the last, which lacks a distal segment, are bisegmental.

As in the case of the mesial and posterior dorsal fins, the interval between the anterior and posterior anal fins is occupied by three vestigial radial elements which complete the continuity of the two series.

Gadus morrhua and *Merluccius vulgaris.*

In both these Gadoids the radial elements are essentially similar to those of the preceding species.

PLEURONECTIDÆ.

Pleuronectes platessa.

Dorsal fin.—The continuous dorsal fin not only extends nearly the whole length of the body but also on to the posterior three-fourths of the head. The supporting radial elements (Pl. XXII. fig. 20), including those on the head, are all bisegmental. The proximal segments (*p.s.*) are long, relatively narrow, vertically disposed structures. Distally, each segment terminates in a

cartilage-tipped extremity, provided with two flat oblique surfaces meeting at an angle. The distal segments (*d.s.*) are all cartilaginous, somewhat plano-convex in shape, and intercalated between the distal ends of the proximal segments in such a way that the convex inferior surface of each articulates with two oblique surfaces furnished by the distal extremities of two contiguous proximal segments. Towards the anterior and posterior extremities of the fin, the distal segments to some extent lose their usual intercalated arrangement and become more directly related to the distal ends of the proximal segments to which they belong.

All the fin-rays are cleft basally and clip the distal segments of their supporting radial elements.

Anal fin.—In the structure and disposition of its radial elements the long anal fin closely resembles the dorsal.

ACANTHOPTERYGII.

BERYCIDÆ.

Holocentrum spiniferosum.

Dorsal fin.—The dorsal fin consists of an anterior spinose portion and a posterior section consisting of soft multiarticulate fin-rays. There is, however, no interruption in the sequence of either the fin-rays or the supporting radial elements. Twenty-five radial elements (Pl. XXII. fig. 21, $r.e.^1$–$r.e.^{25}$) are present, of which the first ten support eleven stout spines, the remaining fifteen supporting sixteen soft rays. The ten spine-bearing elements ($r.e.^1$–$r.e.^{10}$) are bisegmental, each consisting of a dagger-shaped proximal segment (*p.s.*) with well-marked lateral longitudinal ridges, and, in addition, a distal segment (*d.s.*). Each proximal segment has at its distal end (i.) an anterior facet for articulation with the distal segment of the radial element immediately anterior to it; and (ii.) behind the facet a transversely disposed articular surface for the condylar base of a fin-ray. Posteriorly to this the distal end of the segment contracts somewhat, and then widens out into two transversely disposed lateral wings (fig. 22, *p.s.*) which are directed upwards as well as outwards, and, in conjunction with similar wings developed from the distal segment (*d.s.*), form a section of a well-marked medio-dorsal bony groove extending the whole length of the spinose portion of the fin, and serving for the reception of the spines when the latter are deflected. The lateral notches (*n*) which are to be seen

between successive sections of the osseous groove serve for the transmission of the elevator and depressor muscles of the spines. Each distal segment (Pl. XXII. figs. 21, 22, *d.s.*) suturally articulates with the hinder margin of the distal end of the corresponding proximal segment, and consists of (*a*) a central nodular portion, (*b*) the lateral wings already mentioned, and (*c*) a hook-shaped prolongation (*h*) from the centre of its hinder margin, which, after curving backwards and a little downwards, becomes firmly connected by ligament with an osseous tubercle (*t*) on the adjacent distal end of the proximal segment of the next succeeding radial element in such a way that the hook and tubercle together form a bony link or loop. Posteriorly, the distal segment articulates with the anterior of the two facets with which the distal end of the next succeeding proximal segment is furnished.

The spinose fin-rays have much the same structure throughout the series. In each case the base of the spine forms a transversely elongated condyle for articulation with a similar facet on the distal end of the proximal radial segment, immediately behind that to which it rightly belongs; while above the condyle the base of the spine is perforated by a foramen, through which passes the bony hook formed by the distal segment of its proper radial element, that is, the next anterior element.

The evolution of this method of articulation between a distal radial segment and a fin-ray is, I believe, an extreme modification of the "peg-and-socket" articulation, the first appearance of which was noted in the *Conger* and a later stage in *Citharinus*. The ingrowths from the inner surfaces of the originally cleft base of a fin-ray have now met and fused, forming a transverse basal condyle for articulation with a proximal radial segment, but above the condyle there is left a foramen through which passes the now contracted and hook-like posterior portion of the distal segment. This mode of articulation is extremely characteristic of many Acanthopterygian Teleosts, and in future will be referred to as a "chain-link," although I may so far anticipate the sequel as to say that "chain-link" articulations may be formed by various methods in different Teleosts.

The first radial element (Pl. XXII. fig. 21, *r.e.*[1]) supports two spines, of which the first has a chain-link articulation with the distal extremity of the proximal segment, while the second spine, the proper ray to this element, has the normal "chain-link" connexion with the distal segment. It is somewhat difficult to account for

the mode of articulation of the first spine; but I am inclined to think that the chain-link in this case is due to a modification similar to that by which the same kind of articulation is brought about in the case of the distal segments and spines of the rest of the fin, viz., by the ingrowth of the basal extremities of an ordinary cleft ray through the distal end of a *proximal* segment.

There is a striking contrast between the radial elements already described and the fifteen ($r.e.^{11}$–$r.e.^{25}$) supporting the sixteen soft rays of the hinder section of the dorsal fin. The elements are all trisegmental, consisting of proximal (*p.s.*), mesial (*m.s.*), and distal (*d.s.*) segments, which have almost precisely similar relations to one another, and to those of contiguous elements, as in the Cyprinidæ and other Teleosts with trisegmental radial elements. Behind the fifteenth there is a vestigial proximal segment (*v.e.*) suturally united to the one in front.

Each fin-ray is cleft basally and clips the distal segment of its proper radial element, although, as usual, the ray is partly supported by the next succeeding proximal segment. The distal segment of the last element contributes to the support of two rays.

Immediately anterior to the first radial element of the dorsal fin there are two vestigial elements without rays.

Anal fin.—There are twelve radial elements (fig. 23) and fifteen fin-rays, and, of the latter, four are spinose and the remainder soft and multiarticulate.

The third to the twelfth radial elements inclusive ($r.e.^{3}$–$r.e.^{12}$) are trisegmental and in every respect similar to those in the hinder section of the dorsal fin, but the first and second ($r.e.^{1}$–$r.e.^{2}$) have only proximal and distal segments (*p.s.*, *d.s.*). The proximal segments of the first two elements are exceptionally long and stout, and are firmly, but suturally, united together; the remainder are slender and gradually decrease in size as they extend backwards. The distal segment of the third radial element is a simple cubical ossicle similar to those of the succeeding elements; but those of the first and second consist of a cubical body produced distally into anterior and posterior hook-like processes, of which the anterior is simply due to the ossification of the interossicular ligament in continuity with the segment itself. The proximal and distal segments of the first two radial elements furnish either peg-and-socket or chain-link articulations for the first four spinose fin-rays. A tubercle on

the anterior margin of the distal end of the first proximal segment has two lateral pits for the first spine, which therefore has a "peg-and-socket" articulation with that segment. Behind these lateral pits there is a bony loop formed anteriorly by a process of the same segment, and behind by the anterior limb of the distal segment and furnishing a chain-link articulation for the second spine. Posteriorly to this a second ring is formed, partly by the hook-like posterior limb of the same distal segment and completed by the ossified interossicular ligament which extends from the extremity of the hook backwards to the distal extremity of the second proximal segment this bony loop has a chain-link connexion with the third and largest of the spinose rays. Finally, the hooked distal segment of the second element in conjunction with the mesial segment of the third forms a third bony ring for a similar articulation with the fourth and last spinose ray. A comparison of these spines and their relations to their fin-supports renders it clear that the third spine is that rightly belonging to the first radial element, and that the first and second have lost their normal fin-supports and acquired a secondary connexion with the first persistent, ray-bearing element.

All the soft rays are basally cleft and simply clip the distal segments of their supporting radial elements. The last element, however, supports two feebly developed rays.

Beryx decadactylus, Cuv. & Val.

In a figure of the skeleton of this species by Günther (9 *a*, pl. vi.) more or fewer of the radial elements in the soft-rayed portions of the dorsal and anal fins are represented as trisegmental. The sutures between the proximal and mesial segments are somewhat indistinct in the dorsal fin, but are quite obvious in the anal fin. This is the only instance of which I am aware in which the trisegmental character of the radial elements of a Teleost has been previously recognized. It must be pointed out, however, that Günther gives no description of the radial elements, nor does he in any way refer in the text to their segmentation.

Three vestigial elements, consisting of proximal segments only, are figured in front of the first ray-bearing element of the dorsal fin.

PERCIDÆ.

Perca fluviatilis.

Except for the absence of mesial segments, the fins and fin-supports of this species have a fairly close resemblance to those of *Holocentrum*.

Anterior Dorsal fin.—This fin consists of fifteen spinose rays supported by a like number of radial elements. All the radial elements are bisegmental except the last three, which have proximal segments only. Most of the proximal segments have well marked postero-superior processes which appear to take the place of the missing mesial segments. As in *Holocentrum*, all the distal segments are provided with hook-like processes. The distal segment of the first element seems, however, to have fused with the proximal segment, a groove at its base alone indicating its original distinctness.

A median dorsal bony groove for the reception of the deflected spines is present in *Perca*, but the successive sections are formed by lateral wings developed from the postero-superior processes of the proximal segments, in conjunction with those contributed by the distal segments.

The first spine has a "chain-link" articulation with the distal end of the first proximal segment. The second, a similar articulation with the corresponding distal segment, and, in addition, a basal articulation with a transversely elongated articular surface on the distal extremity of the second proximal segment. The remaining spines have precisely similar articulations, two successive elements contributing to the support of each spine. The last three radial elements being without distal segments, it follows that the last and penultimate spines, which are very feebly developed, and rightly belong to the thirteenth and fourteenth elements, are supported solely by the fourteenth and fifteenth proximal segments respectively. The first two of these spines have simple cleft basal ends, without articular surfaces, and merely clip the dorsal extremities of their fin-supports; the third is a simple undivided ray, and is supported by fitting into a cleft in the distal extremity of the last proximal segment.

Anterior to the first ray-bearing radial element there is a vestigial proximal segment which is probably the normal fin-support to the first spine.

Posterior Dorsal fin.—In this fin there are fifteen radial elements all of which consist of a proximal segment, with a well-marked postero-superior process, and a simple cubical distal segment, with no trace of a hooked process. The fifteen fin-rays are all soft and multiarticulate, and their cleft basal extremities simply embrace the distal segments.

Anal fin.—In this fin there are nine radial elements and eleven fin-rays, of which two are spinose and the remainder soft. With the possible exception of the first, all the radial elements are bisegmental, and similar, both in structure and in their mode of articulation with the fin-rays, to those of the posterior dorsal fin. All the proximal segments, except the first, have well-developed postero-inferior processes. The first element has no distinct distal segment, but it is nevertheless possible that the bony loop which grows backwards from the hinder margin of the distal end of its proximal segment, and fuses with the contiguous extremity of the second proximal segment, may, as in the anterior dorsal fin, represent a fused distal segment. The first spine has a "chain-link" articulation with the proximal segment of the first radial element; the second a similar articulation with the bony loop between the proximal segments of the first and second elements; while the remaining soft rays clip the distal segments of their respective radial elements, the last two rays, however, being supported by the same distal segment.

Mesoprion gembra.

Dorsal fin.—Although a continuous structure, the dorsal fin consists of an anterior spinose portion and a posterior section composed of soft multiarticulate rays. The spinose portion consists of ten spines supported basally by a series of eight bisegmental (Pl. XXII. fig. 24, $r.e.^1$–$r.e.^4$) radial elements, all of which, including the first, have distinct hooked distal segments. Both in structure and in their articular relations to the spinose fin-rays, the radial elements are similar to the corresponding elements in *Perca*, except that neither the postero-superior processes of the proximal segments nor the distal segments develop lateral wing-like outgrowths, and hence there is no obvious bony groove for the deflected spines.

In addition to its normal spine, the third, the first radial element supports two additional spines, viz., the first and second, which are connected with the anterior portion of the distal end

of the proximal segment by "chain-link" articulations (*r.e.*[1], *p.s.*). Three vestigial proximal segments without fin-rays lie anterior to the first ray-bearing radial element.

In the soft posterior section of the fin there are fourteen radial elements, exclusive of a small vestigial proximal segment behind the last ray-bearing element. All are bisegmental (fig. 25) except the last four, which, curiously enough, possess a separable mesial segment, and are therefore trisegmental, and each supports a soft fin-ray. The connexion of the rays with the distal segment is by means of a "peg-and-socket" articulation in the case of the more anterior ones; posteriorly, however, the cleft rays merely embrace the distal segments.

Anal fin.—In this fin there are nine radial elements, of which the first to the sixth inclusive are bisegmental (Pl. XXII. fig. 26, *r.e.*[1]–*r.e.*[3]) and the last three trisegmental. The first supports three spines, two by means of "chain-link" articulations and the third by its hooked distal segment, precisely as in the first radial element of the dorsal fin. The remaining eight soft rays are also supported in much the same way as those of the hinder section of the dorsal fin.

There is a small vestigial proximal segment immediately behind the last ray-bearing element.

SPARIDÆ.

Pagellus centrodontus.

Dorsal fin.—In *Pagellus* the dorsal fin consists of twenty radial elements, of which the anterior ten support twelve spinose rays and the remainder a series of soft rays. Anterior to the first spine-bearing element three vestigial elements are represented by their massive T-shaped proximal segments without fin-rays. The spine-bearing elements are almost precisely similar to those of *Perca*. The postero-superior processes of the proximal segments and the distal segments possess unusually well-developed lateral wings, so that the groove for the deflected spines is exceptionally well marked.

In addition to its proper ray, the third, the first radial element supports two additional spines, of which the first has an incomplete "chain-link" articulation with the distal end of the proximal segment and the second a complete one.

The ten radial elements which support the soft rays are all bisegmental, resembling in this respect, as well as in the method by

which their rays are supported, the majority of the corresponding rays in *Perca*. The distal segment of the last radial element supports two rays, and in sutural connexion with the proximal segment of the same element there is a vestigial proximal segment which has no fin-ray.

All the distal segments in this portion of the fin appear to consist of two conjoined lateral halves separated by a distinct median longitudinal suture.

Anal fin.—There are ten bisegmental radial elements, and behind the last of the series a vestigial proximal segment similar to that in the dorsal fin. The first radial element supports three spines—two by "chain-link" articulations with the distal end of the proximal segment, and the third, the proper ray of this element, by the hooked distal segment. The remaining ten rays are soft and most of them have a "peg-and-socket" articulation with the distal segments of their respective radial elements. The distal segment of the last element, however, supports two rays.

SCOMBRIDÆ.

Scomber scomber.

Although essentially similar in structure to those of the preceding Acanthopterygian Teleosts, there are nevertheless certain interesting variations in the structure of the dorsal and anal fins in this species. The dorsal fin consists of (*a*) an anterior spinose portion; (*b*) a median non-spinose section; and (*c*) a series of six detached finlets extending backwards to the root of the caudal fin. It is, however, worthy of note that so far as the supporting radial elements are concerned there is no interruption in the continuity of these externally distinct divisions of the fin. The anal fin also consists of an anterior section succeeded by six detached finlets.

Anterior Dorsal fin.—Fourteen radial elements are present, all of which are bisegmental. Each of the first nine consists of a proximal segment, with a postero-superior process, and a hooked distal segment. Both the postero-superior processes and the distal segment have well-developed lateral wings, and the medio-dorsal bony groove of which they form the sections is, in consequence, unusually deep and broadly V-shaped. Towards the hinder end of the fin the proximal segments gradually diminish in size, and in the tenth radial element the distal segment loses its

hooked process. In the eleventh and succeeding elements the distal segments retain only a loose ligamentous connexion with the postero-superior processes of their proximal segments, and become entirely supported by the proximal segments of the next succeeding radial elements, instead of by two contiguous segments as is the case with the more anterior ones.

There are fourteen spinose fin-rays which gradually decrease in length from before backwards, the hinder ones being purely vestigial. The transversely elongated basal condyle of the first spine fits into a similarly disposed groove on the distal end of the proximal segment of the first radial element; the second spine has the usual "chain-link" articulation with the distal segment; and the remaining spines, as far as that normally belonging to the ninth element, have similar articulations. The succeeding spines have, however, simple cleft basal extremities, which clip the distal ends of the proximal radial segments immediately posterior to those to which they strictly belong. The last radial element has no proper spine, although it supports the spine belonging to the element immediately anterior.

Median Dorsal fin.—There are eleven radial elements, supporting a similar number of fin-rays, of which the first only is spinose. All the elements are bisegmental. The first has a hooked distal segment for articulation with the single spine; all the others have simple cubical distal segments, the more anterior of which have a "peg-and-socket" articulation with their fin-rays, the posterior being simply embraced by the cleft bases of the rays. Between the anterior and median divisions of the dorsal fin there is a continuous series of fifteen vestigial proximal segments in the form of slender splint-like ossicles, embedded in the median fibrous septum between the dorsal muscles, and indicating the primitive continuity of the two fins.

The Finlets.—Six radial elements support the six detached finlets, and form a continuous series with one another and with those of the median dorsal fin. Their adaptation for mutual support is brought about by the excessive elongation of their postero-superior processes, which enables each process slightly to overlap the base of the corresponding process of the next succeeding proximal segment. Each of the elements is bisegmental, and its distal segment is clipped in the usual fashion by the cleft base of the single multiarticulate and branched fin-ray of which each finlet is composed.

Anal fin.—The anterior division of the anal fin consists of twelve bisegmental radial elements, supporting thirteen fin-rays. The first element supports two spinose rays, the first by a "chain-link" articulation with the distal end of its proximal segment, and the second by an articulation with the hooked distal segment, in conjunction with a facet on the proximal segment of the second radial element. The remainder support soft rays in the ordinary way. The relations of the six radial elements supporting the six isolated finlets to one another and to those of the anterior part of the anal fin are precisely as in the dorsal fin.

Carangidæ.

Caranx georgianus.

Apart from variations in the number of radial elements and fin-rays and other minor differences, the dorsal and anal fins of *Caranx* are essentially similar to those of the more typical Acanthopterygii, such as *Perca* and *Pagellus*.

Sphyrænidæ.

Sphyræna Commersonii.

This Teleost is interesting as affording a transition from the more typical Acanthopterygii previously described to such families as the Cottidæ and Mugilidæ, in which more or fewer of the radial elements of the dorsal fin become unisegmental by the loss of their distal segments.

Anterior Dorsal fin.—The short anterior dorsal fin of this species consists of five radial elements (Pl. XXII. fig. 27) and an equal number of spinose rays. All the radial elements, except the last, are bisegmental, and the postero-superior processes of their proximal segments in conjunction with the distal segments form sections of a shallow medio-dorsal bony groove, as in many of the preceding types. None of the distal segments are hooked, and the method by which the fin-rays are supported is very unlike anything hitherto described. All the spines are furnished with imperforate bases terminating in a transversely elongated condyle. The first spine (*sp.r.*) articulates with a groove on the distal end of the proximal segment of the first radial element, but with all the remaining spines (figs. 27 and 28) the groove (*g*) for the reception of the condyle is formed by the distal

and proximal segments of two contiguous radial elements, the groove being bounded anteriorly by the posterior margin of a distal segment (*d.s.*), and behind and below by the anterior portion of the distal extremity of the next proximal segment (*p.s.*). As the second spine is the normal fin-ray of the first radial element, it is evident that the last element has no proper spine of its own, although it contributes to the formation of the groove for the fifth spine.

Three large T-shaped vestigial radial elements are situated immediately anterior to the first spine-bearing one.

Posterior Dorsal fin.—There are ten radial elements and eleven fin-rays. Of the radial elements the first five are bisegmental; the remainder, owing to the presence of mesial segments, are trisegmental. Behind the last there is a vestigial proximal segment partially fused with the corresponding segment of the antecedent radial element.

The first fin-ray is a spine, and its mode of articulation with the distal segment of the first radial element affords a further illustration of the method by which an ordinary cubical distal segment may become converted into a "hooked segment," with its characteristic articulation with the perforate base of a fin-ray. The distal segment in question is cubical anteriorly but behind contracts into a short, slightly curved hook-like process. The cleft base of the spine has two ingrowing processes, which, however, do not meet so as to bound a complete basal foramen; nevertheless, the hooked end of the distal segment fits into this incomplete foramen. The formation of the hook-like process seems, without doubt, to be due to the ingrowth of the two processes of the spine, and the consequent constriction of the posterior half of the segment to the condition of a relatively slender hook, which, however, still retains its normal position in the cleft of the spine. The distal segment of the second radial element is somewhat similar to that of the first, but more closely resembles the ordinary cubical distal segments of the rest of the fin, which are simply clipped by the cleft bases of the fin-rays. The last distal segment supports two feeble fin-rays.

Anal fin.—Nine radial elements and eleven fin-rays are present in this fin. The fin-supports are similar to those of the posterior dorsal fin, and, as in the latter, certain of them are trisegmental, viz. the sixth to the ninth inclusive, while the remainder are bisegmental. Behind the last of the series there is a vestigial

proximal segment suturally joined to the penultimate one. The first radial element supports two rays, and the last also two. The distal segments of the first two radial elements have incipient "chain-link" articulations with the second and third rays, as in the second dorsal fin.

COTTIDÆ.

Trigla gurnardus.

Dorsal fin.—This fin consists of a continuous series of twenty-nine radial elements supporting anteriorly eleven spinose rays and posteriorly nineteen soft, flexible, but unbranched rays. The first ten radial elements (Pl. XXIII. fig. 29) are unisegmental, consisting of proximal segments (*p.s.*) only. Each proximal segment is produced into a postero-superior process which is provided with well-developed lateral wings for the enclosure of a section of the medio-dorsal groove (fig. 29). The wings are somewhat contracted at their origin, but expand distally so as to overlap in an imbricated fashion the similar wings of contiguous segments, and, in consequence, the usual clefts between them for the transmission of the depressor and elevator muscles of the spines become converted into complete foramina (*f*). At the distal end of each proximal segment, near its anterior margin, there are two articular facets, one (*fc.*[1]) for articulation with the hinder margin of the postero-superior process of the proximal radial segment in front, and a second (*fc.*[2]), situated immediately in front of the first, for articulation with the condylar base of a spine.

The eleven spinose rays have imperforate bases terminating in a transversely elongated condyle, and in the absence of distal radial segments each spine is supported *solely* by the facet on the proximal segment immediately behind that to which it properly belongs. The second spine is that which strictly belongs to the first radial element, the first really belonging to an anterior suppressed element. The eleventh element supports the eleventh spine, in addition to the first of the series of flexible rays. The last three spines are more or less vestigial, and hence, externally, there is an apparent interruption in the continuity of the spinose and soft sections of the fin.

The remaining nineteen radial elements are precisely similar to those of the anterior portion of the fin except that they all possess nodular bony distal segments, which have the usual articulation with their own proximal segments and also with

those immediately posterior. The segments are clipped by the cleft bases of the soft rays.

Anal fin.—In this fin there are seventeen radial elements and nineteen fin-rays. The radial elements are all bisegmental and resemble those of the posterior section of the dorsal fin, except that the postero-inferior processes of the proximal segments have no lateral wing-like outgrowths. The fin-rays are also similar, but the first and last of the supporting radial elements carry each two rays.

MUGILIDÆ.

Mugil capito.

This species has an anterior and a posterior dorsal, and an anal fin.

Anterior Dorsal fin.—There are four radial elements (Pl. XXIII. fig. 30) consisting of proximal segments only, and a like number of spinose fin-rays. The distal end of each proximal radial segment forms a transversely elongated groove into which fits a similarly elongated condyle formed by the base of a spinose ray. The first three spines have perforated bases, the foramen being situated just above the basal condyle; the fourth, however, is imperforate. In addition to its basal support the first spine has a "chain-link" articulation with the first radial element; the second a "hook-link" articulation, the hook * being developed from the hinder margin of the distal end of the second radial element, and curving forwards so as to hook into the foramen in the base of its spine; the third, like the fourth, has a simple condylar articulation with its supporting radial element, although its base is perforate.

Posterior Dorsal fin.—In this fin there are nine radial elements and eight soft fin-rays. With the exception of the ninth, which has neither a distal segment nor a fin-ray, all the radial elements are bisegmental, and each supports a fin-ray. The fin-rays are cleft basally, and clip the distal segments of their respective radial elements.

Three vestigial unsegmented radial elements are present in the somewhat considerable interval which separates the two dorsal fins.

Anal fin.—There are ten bisegmental radial elements and thirteen fin-rays. The proximal segment of the first element

* Vide *Anarrhichas lupus*, p. 573.

has a "chain-link" articulation with the first ray, and, besides furnishing a hook-like process which curves backwards and hooks into the perforated base of the second ray, contributes by its distal segment to the support of its proper ray—the third. The remaining fin-rays clip their distal radial segments in the usual fashion, but the last two are both supported by the same distal segment, viz., that belonging to the last radial element.

Blenniidæ.

Anarrhichas lupus.

Dorsal fin.—In the long dorsal fin of this species there are seventy-five radial elements and seventy-six long flexible spinose fin-rays. All the radial elements are unisegmental (Pl. XXIII. fig. 31), consisting only of proximal segments (*p.s.*) without any trace of mesial or distal segments; and, with the exception of the last, all support in a precisely similar fashion their respective fin-rays. Near its distal extremity each proximal segment abruptly contracts into a nearly vertical postero-superior process, and from the anterior surface of this process a slightly curved bony hook extends forwards. The anterior extremity of the hook is connected by ligament with the distal end of the postero-superior process of the proximal segment immediately anterior, and I have no doubt that in this species, as with the second radial element of the anterior dorsal fin of *Mugil*, the hook owes its existence to the partial ossification of the ligament (interossicular ligament) which extends between the postero-superior processes of contiguous proximal segments. On the anterior side of the base of the postero-superior process there are two laterally situated facets (*fc.*) for the fin-ray.

Each fin-ray (*f.r.*) is cleft proximally into two basal arms, which converge somewhat without actually meeting, and finally terminate in two condylar extremities. Each ray is supported solely by a single radial element, partly by its two basal condyles which articulate with the two facets at the base of a postero-superior process, and partly by the extension of the hooked process of the latter through the nearly complete foramen enclosed by the cleft base of the ray. The rays are further retained in position by a stout longitudinally disposed ligament passing between their basal extremities, and also between the postero-superior processes of successive proximal segments. Of

the last two fin-rays, the first has the normal relations to the last radial element, but the second merely embraces the hinder margin of the postero-superior process.

It is worthy of note that, owing to the suppression of the distal segments of the various radial elements, each fin-ray is *solely* supported by its secondary connexion with the element immediately posterior to that to which it rightly belongs.

Anal fin.—The anal fin is altogether more normal in the structure and relations of its radial elements, of which there are forty-five, supporting an equal number of fin-rays. All the elements (Pl. XXIII. fig. 32, *r.e.*) have well-developed distal (*d.s.*) in addition to proximal (*p.s.*) segments, and the position and relations of the former are such that each is supported partly by the corresponding proximal segment, and partly also by that pertaining to the next succeeding element. The distal segments are apparently ossified from two lateral centres, and in the specimen examined, which was about two and a half feet in length, were still separated by an intervening tract of cartilage.

All the fin-rays are cleft proximally and embrace the distal segments of their supporting radial elements.

Labridæ.

Pseudoscarus superbus.

Dorsal fin.—There are eighteen radial elements and nineteen fin-rays. The first eight of the series of radial elements (Pl. XXIII. fig. 33, $r.e.^1$–$r.e.^8$) are all unisegmental, consisting only of proximal segments (*p.s.*). Each proximal segment is more or less dagger-shaped, with a short and nearly vertical postero-superior process, as in *Anarrhichas*. At its distal extremity a slender bar of bone passes from the base of the postero-superior process, and, curving downwards and forwards, fuses with the anterior margin of the segment in such a way as to form the outer half of a bony chain-link. The ninth proximal segment ($r.e.^9$, *p.s.*) differs from the preceding in the greater length and oblique backward prolongation of its postero-superior process, and also in the fact that it possesses an osseous distal segment (*d.s.*) for the support of the first soft ray in addition to the more anteriorly placed "chain-link" for the last of the spinose rays. The remaining elements are essentially similar to the ninth, although they have no "chain-link" and gradually decrease in size. Behind the

eighteenth, to the proximal segment of which it is suturally attached, there is a small osseous nodule which apparently represents an additional vestigial element.

The nine spinose rays have perforate bases for articulation by "chain-links" with the first nine of the series of radial elements. The ten soft rays, on the contrary, have the usual cleft bases for the reception of the distal segments of the radial elements from the ninth to the eighteenth, inclusive. Both the ninth and tenth soft rays, however, are supported by a single distal segment, viz., by that belonging to the last radial element.

The nature of the "chain-link" of the first nine radial elements appears somewhat puzzling. At first sight it seemed possible that it might owe its formation to the fusion of a hooked distal segment of one radial element with the anterior distal margin of the next succeeding proximal segment; but it is certain that no trace of any such fusion can be detected even if sections be taken through the possible line of junction and microscopically examined. On the other hand, it seems extremely probable that the chain-link results from a further extension of a modification already pointed out in the case of *Anarrhichas*, and also in the second radial element of the anterior dorsal fin of *Mugil*. If the hook-like process of a proximal segment in these Fishes were to curve forwards and downwards to a still greater extent, as the result of a further ossification of the interossicular ligament, and eventually fuse in front with the anterior margin of the segment, we should at once have a chain-link precisely similar to that of *Pseudoscarus*. This conclusion derives additional support from the essential similarity of the anterior radial elements of *Pseudoscarus* to those supporting the entire fin in *Anarrhichas*. In both genera the postero-superior processes are nearly vertical, and the fin-rays are supported solely by the radial elements immediately posterior to those to which they rightly belong.

Anal fin.—In the anal fin there are ten radial elements and twelve fin-rays. All the radial elements are bisegmental. Behind the last there is a vestigial proximal segment, without a fin-ray, as in the dorsal fin.

Of the three anterior spinose rays the first two articulate with the distal end of the proximal segment of the first radial element. The first spine is cleft proximally and simply clips the distal margin of the segment, while the second has a transversely

extended basal condyle fitting into a corresponding groove. The base of the third spine is perforated by a foramen, into which projects the contracted hinder end of the distal segment of the same element. The soft rays immediately behind the last spine have "peg-and-socket" articulations with the distal segments, but the more posterior rays simply embrace those segments in the usual manner. The distal segment of the last radial element supports the last two rays, the second of which probably belongs to the vestigial element.

Labrichthys tetrica.

This species very closely resembles the preceding in the character of its radial elements, and also in the mode of articulation of the fin-rays to their supporting elements. Anterior to the first of the ray-bearing series there is a vestigial element, in addition to one behind the last of the series.

FISTULARIIDÆ.

Aulostoma chinense.

Anterior Dorsal fin.—The continuous anterior spinose section of the dorsal fin of other Acanthopterygii is represented in *Aulostoma* by a series of eleven slender isolated spines, supported by a corresponding number of similarly isolated radial elements. Each radial element consists only of a proximal segment, which is transversely grooved at its distal end for articulation with a similarly modified condyle furnished by the uncleft base of a spinose ray. The various segments are almost horizontally disposed, the proximal extremity of each being directed forwards.

Posterior Dorsal fin.—In this there are twenty-five radial elements and twenty-seven soft fin-rays. All the radial elements, except the last two, are bisegmental, consisting of both proximal and distal segments, the former having well marked postero-superior processes, and both having the usual relations for mutual support. The last two of the series have a single large distal segment between them, and this supports four fin-rays. All the remainder support each a single fin-ray.

Anal fin.—This fin very closely resembles the posterior dorsal in all essential features.

Cyclopteridæ.

Cyclopterus lumpus.

Dorsal fin.—The hinder dorsal fin of this species, corresponding to the non-spinose portion of the dorsal fin of other Acanthopterygii, consists of ten soft rays, supported by an equal number of radial elements, all of which are bisegmental. The proximal segments of the radial elements are nearly straight, or at any rate are so slightly angulated at their distal extremities as to present only slight traces of postero-superior processes. The distal segments are small nodular ossicles. The connexion of the distal and proximal segments of the same radial element, and with those of contiguous elements, is loose and ligamentous, and there are no articular relations between the different elements for mutual support.

The basal ends of the cleft fin-rays are rugose and without basal articular surfaces: their cleft proximal extremities embrace the distal radial segments.

Anal fin.—This fin is precisely similar to the dorsal.

Trachypteridæ.

Regalecus argenteus.

From Parker's description and figures [1] of the dorsal fin of this species, it would seem that the supporting radial elements are bisegmental. Except for a short distance anteriorly each proximal radial segment is V-shaped, consisting of an anterior and a posterior arm, and a stem. The posterior arm is apparently the equivalent of the postero-superior process of other Teleosts, but the anterior arm is, so far as I am aware, peculiar. The segments are so arranged in longitudinal series that the distal extremity of the anterior arm of one abuts against the extremity of the posterior arm of the segment immediately anterior, while between the two, and supported to an equal extent by both, is the distal radial segment, clipped by the cleft base of its fin-ray. In the more anterior elements the two arms become merged in a single triangular plate. The first five proximal segments are partially fused and otherwise modified to support the fin-rays of the characteristic head-crest of this species.

There is no anal fin.

Lophobranchii.

Syngnathidæ.

Siphonostoma typhle.

Here is a well-developed dorsal fin and a small, almost vestigial anal fin.

Dorsal fin.—This fin consists of thirty-four bisegmental radial elements, supporting a like number of soft fin rays. The proximal radial segments are very slender splint-like bones without any trace of lateral longitudinal ridges, and exhibiting a slight tendency to become arranged in groups of four each. In each group the segments converge slightly towards their proximal ends, where they are firmly attached to the summit of the neural arch of a subjacent vertebra. Distally, the segments diverge slightly and their dorsal extremities expanding somewhat come into apposition, and form with one another and with those of other groups a continuous peripheral margin. The distal segments consist of a series of rounded cartilaginous nodules connected with one another longitudinally by ligament, and but loosely connected by the same means with the distal extremities of the proximal segments.

The fin-rays are slightly bifurcate at their basal extremities and partially embrace the distal radial segments, to which they are intimately united by fibrous tissue.

Hippocampus guttulatus.

Except for reduction in number, the fin-rays and their radial elements in this species are essentially similar to those of the preceding.

Plectognathi.

Sclerodermi.

Balistes capriscus.

Anterior Dorsal fin.—The three spinose rays, with their osseous supports and muscles, in *Balistes vetula* have been described and figured by Sörensen [10]. The corresponding structures in *B. capriscus* are precisely similar, except for the diminutive size of the third spine. The radial elements supporting the

modified and highly specialized spines have apparently fused together to form a curious boat-like structure furnished with two large lateral foramina, through which are transmitted the depressor muscles of the first spine and the erectores of the second. Anteriorly this singular fin-support rests on the posterior face of the skull, and behind it is attached by ligament to the distal end of a fairly stout, shaft-like bone, the "tige apophysaire" of Holland *, the proximal extremity of which is in ligamentous connexion with the distal end of one of the anterior neural spines. The identification of the component elements of the fin-support is extremely difficult in adult specimens, and hence any comparison with the more normal elements of the posterior dorsal fin is likely to prove misleading. I am inclined to think that three radial elements enter into its formation, but to what extent the usual segments of these elements are represented I can offer no opinion.

Posterior Dorsal fin.—In this fin there are twenty-seven radial elements, supporting a corresponding number of soft, branched and multiarticulate fin-rays. All the radial elements (Pl. XXIII. fig. 34, *r.e.*) are bisegmental, each consisting of a proximal (*p.s.*) and a distal (*d.s.*) segment. The proximal segments exhibit a general resemblance to the ordinary dagger-shaped bones of other Teleosts, and for the greater part of the length of their parallel and serrated anterior and posterior margins are in close sutural connexion with one another, the union in those more posterior extending even to partial anchylosis; they also interdigitate with the subjacent neural spines, to which they are firmly and rigidly attached. Superiorly, the proximal segments terminate in cartilaginous extremities, which are in close apposition and form an even dorsal margin traversed by a slight longitudinal groove for articulation with the series of distal segments. On the outer surface of each proximal segment there is a prominent longitudinal bony ridge, which, however, ceases a little short of the extreme distal end of the segment.

The distal segments, on the contrary, are small, somewhat cubical, cartilaginous nodules with flat distal and convex proximal surfaces, and so arranged that while in close ligamentous connexion with one another in a longitudinal series they tend to alternate with the proximal segments. The connexion

* Quoted by Sörensen, *l. c.*

between the distal and proximal segments is less intimate than in most other Teleosts. To some extent the series of distal segments articulate with the longitudinal groove on the distal margin of the series of proximal segments, and a short, relatively stout ligament passes from each distal segment to the subjacent proximal segments; but the articulation between the two series of segments is, nevertheless, unusually mobile—in fact, the connexion of the distal segments with one another is much more intimate than is their relation to the series of rigidly interconnected proximal segments.

Each fin-ray (*f.r.*) is cleft basally and the two arms, which terminate inferiorly in thin, plate-like expansions, and not in articular surfaces, closely and firmly clip a distal radial segment.

Anal fin.—In the anal fin there are twenty-four radial elements and a corresponding number of soft fin-rays, both of which in structure and in mutual relations precisely resemble those of the posterior dorsal fin.

Monacanthus granulosus.

As in *Balistes*, this species is provided with a short spinose anterior dorsal fin and a soft posterior one, in addition to an anal fin.

Anterior Dorsal fin.—Sörensen [**10**] has also figured and described the two spines with their supports and muscles in *M. pardalis*, to which species *M. granulosus* exhibits a fairly close resemblance in so far as the structures in question are concerned. The bony support for the spines is somewhat similar to that of *Balistes capriscus*, but is shallower, with the two lateral foramina replaced by notches, and, as it is wholly supported by the hinder part of the cranial roof, the "tige apophysaire" is wanting. As in *Balistes*, the fin-support bears no resemblance to the ordinary radial elements of the posterior dorsal fin, and no suggestion can therefore be offered as to the number or nature of such elements, or their segments, which enter into its formation.

Posterior Dorsal fin.—This fin is very similar to the corresponding fin in *Balistes*, and consists of twenty-eight or twenty-nine radial elements and a corresponding number of soft rays. The proximal radial segments are firmly connected with one another by squamous sutures, and also with the subjacent neural

spines between which they are interposed. In addition to the lateral longitudinal bony ridge, each segment is furnished with two lateral bony processes projecting outwards at right angles to its long axis from a point a little below its distal end. The distal segments are also similar to those of *Balistes* in their relations and connexions *inter se*, the mobility of their articulation with the proximal segments, and in their mode of insertion into the cleft bases of their fin-rays.

Anal fin.—In almost every respect the anal fin is similar to the posterior dorsal fin.

Gymnodontes.

Tetrodon immaculatus.

Dorsal fin.—In this species the single short dorsal fin, which is apparently the equivalent of the posterior dorsal fin of the preceding species, consists of ten soft rays supported by a series of seven radial elements (Pl. XXIII. fig. 35, *r.e.*^{1}–*r.e.*^{7}). All the elements are bisegmental. Their proximal segments (*p.s.*) are elongated and somewhat irregular in shape, without any trace of the usual lateral longitudinal ridges, and all are more or less firmly connected together for a portion of their length by squamous sutures. The cartilaginous distal extremities of the segments fuse together into a continuous peripheral margin (*c.m.*), which is separated from, but at the same time loosely connected with, the distal segments by an intervening tract of fibrous tissue (*l.g.*).

The distal segments are represented by a series of simple, cubical, cartilaginous nodules (*d.s.*), widely separated from the proximal segments, although corresponding with them in number. As in the two preceding species, the distal segments are intimately connected together in a longitudinal series by fibrous tissue.

The ten fin-rays have cleft bases, into which are inserted the supporting distal radial segments. Towards the hinder part of the fin more than one ray may be wholly or in part supported by the same distal segment.

Anal fin.—In this fin there are only four radial elements (fig. 36, *r.e.*^{1}–*r.e.*^{4}), but at least ten soft fin-rays. The proximal radial segments (*p.s.*) are firmly connected together although, perhaps, less intimately than in the dorsal fin, and the first of

the series is exceptionally long and stout. The four cartilaginous nodules representing the distal segments (*d.s.*) do not correspond in position with the dorsal extremities of their proximal segments, but are concentrated towards the anterior border of the fin, and support in the usual manner the first four fin-rays. The remaining rays have their bases imbedded in a posterior extension of the fibrous tissue (*l.g.*), which in the anterior part of the fin connects the fused cartilaginous extremities of the proximal segments with the distal segments. In all other respects the anal fin closely resembles the dorsal.

Diodon hystrix.

Dorsal fin.—There are eleven proximal radial segments (Pl. XXIII. fig. 37, *p.s.*), all of which, except the first and last, are cylindrical for the middle portion of their length, but fused distally into a continuous, dorsally grooved, cartilaginous margin (*c.m.*), while their expanded and cartilage-tipped proximal extremities are suturally united and at the same time firmly wedged in between the neural spines of the subjacent vertebræ. The first and last of the series are much more massive and differ somewhat in shape from the others. The distal segments (*d.s.*) are more numerous than the proximal, being sixteen in number. The first is thick and cubical in shape; the remainder are more or less elongated cartilaginous rods, except the last two or three, which are much shorter and approximate to the condition of simple nodules. The fin-rays are also sixteen in number, and their bifid basal ends (fig. 38, *f.r.*) ensheath the distal radial segments (*d.s.*).

Anal fin.—This fin consists of nine proximal radial segments, fifteen distal segments, and fifteen soft fin-rays, but in all other respects it is almost precisely similar to the dorsal fin.

Orthagoriscus mola.

The fins and fin-supports of this species, with the remaining portions of the skeleton, have been described and figured by Wellenbergh [13] and Cleland [14]. As far as the fins are concerned, Cleland's account and figures are on the whole the more detailed and accurate, but in some respects his description is either incomplete or not sufficiently clear to admit of the comparison of these structures with those of other Teleosts. For this reason I have thought it desirable to revise Cleland's

account in the light of an examination of a specimen of the same species which I have recently had the opportunity of dissecting.

Dorsal fin.—In all essential features this fin closely resembles that of *Diodon hystrix*. In the series of radial elements there are fifteen proximal segments and seventeen distal. Of the proximal segments, the first differs in shape from the others, and, as it takes no share in the support of the fin-rays, simply acts as a buttress to the second, to the anterior margin of which it is closely applied. The remaining proximal segments are expanded and flattened out at their proximal extremities, where they are in close contact with one another and, at the same time, wedged in between the vertebral neural spines. Towards their distal ends the segments contract and become nearly cylindrical, and, finally, their cartilaginous distal extremities fuse indistinguishably into an exceptionally thick, longitudinally disposed mass of cartilage, which is marked by a longitudinal groove along its dorsal border and traversed by a succession of deep vertical grooves on each of its lateral surfaces for the passage of the tendons of the fin-muscles.

The distal segments vary considerably in size and shape. The first is short, thick, and somewhat flattened laterally; the succeeding four or five rapidly elongate and become thick, four-sided, tapering cartilaginous rods; those following, while retaining much the same shape, gradually diminish in length and become more slender; while the last two or three of the series are irregularly shaped cartilaginous masses. All the distal segments are firmly connected with one another by ligament, and their rounded proximal ends fit into the longitudinal groove on the dorsal margin of the proximal segments; they are also in ligamentous connexion with the proximal segments, but the union is, nevertheless, of such a character that the distal segments and their fin-rays are capable of a considerable range of ateral movement on their basal supports.

The fin-rays agree in number with the distal radial segments. Of the anterior six the first is short, but the others, rapidly increasing in length, remain undivided and support the relatively unyielding anterior margin of the fin. The remaining eleven rays fray out, as it were, at the distal ends and, gradually diminishing in length, support the flexible cutaneous fold which fringes the posterior margin of the fin from its apex downwards.

Each fin-ray is cleft longitudinally for the proximal three-fourths of its length, and its lateral halves expand towards the base of the ray into thin splint-like plates, and firmly embrace between them for nearly its whole length one of the distal radial segments. In striking contrast to their massive supporting cartilages, the posterior two or three rays are very feebly developed.

Anal fin.—In the anal fin there are eleven proximal radial segments, and fifteen distal segments supporting a like number of fin-rays. Except for the partial fusion of the first two proximal radial segments, the fin and its fin-supports differ but little from the description of the dorsal fin given above.

III. SUMMARY.

In this section it is proposed to institute a comparison of the principal modifications of the radial elements of the mesial fins with regard to their degree of segmentation, the extent to which they are affected by degeneration and concrescence, and the variable modes of support they offer to the fin-rays, in different groups of Fishes.

The most primitive type of radial element is to be found in the Marsipobranchs, where they exist in the form of unsegmented cartilaginous rods, either simple or dichotomously branched towards their distal ends, and, in the absence of horny fibres or fin-rays, they extend to the peripheral margins of the fins and constitute their sole skeletal support.

In retaining the condition of simple unsegmented cartilaginous rods, the radial elements of the Holocephala resemble those of the Marsipobranchs; but how far the simplicity of these structures is primitive, or has been acquired by the suppression of segments, cannot at present be determined. Actinotrichia in the form of horny fibres support the periphery of the fins.

In the most primitive of extinct Elasmobranchs (e. g. *Cladoselache*, *Pleuracanthus*) the radial elements of the dorsal fins become complicated by segmentation, each being divided into a basal and a distal segment, of which the distal is the longer. As pointed out by Dean [**11**], the various elements extend to the periphery of the fin and in conjunction with horny fibres, which in *Cladoselache* are of secondary importance and lie between the former, contribute to the support of the fin.

In the Arthrodira (e. g. *Coccosteus*) [Smith Woodward, 12] the radial elements are very similar bisegmental structures.

In existing Elasmobranchs the typically rod-like cartilaginous radial elements are generally trisegmental, exhibiting a division into proximal, mesial, and distal segments, flexibly connected with one another by ligament, and in fairly close apposition throughout their length for mutual support. The central or approximately central elements are usually the longest, and almost invariably the most anterior and posterior undergo reduction in length and lose one or more of their constituent segments—facts which find their legitimate explanation in the partial atrophy of an originally more extensive fin and the concentration of the persistent residue of the fin-supports. The horny fibres, as was probably also the case in the fossil Elasmobranchs above-mentioned, are much more numerous than the supporting cartilages, and to a greater extent than in extinct types they supplant the latter in supporting the flexible peripheral margins of the fins. As has already been pointed out, the radial elements are liable to considerable modifications in different genera through (*a*) the longitudinal concrescence of the proximal segments, or of both proximal and mesial; (*b*) the suppression of particular segments in certain of the elements; and (*c*) the apparently secondary subdivision of the distal segments.

The polymorphic character of existing Ganoids is well illustrated by the existence of striking variations in the structure of the radial elements, of which three well-marked types are represented within the limits of the group.

(1) In *Acipenser* and *Polyodon* the trisegmental radial elements are essentially similar to those of Elasmobranchs in shape and mutual relations, in the large relative size of the mesial segments, the tendency to occasional concrescence on the part of the proximal segments, the excess in the number of dermal fin-rays which they support, and also in the fact that the cleft bases of the fin-rays embrace between them not only the distal but to some extent the mesial segments also. On the other hand, there are not wanting indications of increasing specialization in the partial ossification of the proximal and mesial segments, and the reduction of the distal segments to the condition of simple cartilaginous nodules. The fin-rays also exhibit modifications in the same direction. Not only are they partially ossified, but, although more numerous than the supporting radial elements,

there is not that marked disparity which is so characteristic of Elasmobranchs. Their reduction in number, as well as their increase in size, is presumably due to the fusion of primitive "actinotrichia;" and, in consequence of the more deeply seated position of the radial elements, they now become the chief support of the external portions of the fins.

(2) In *Amia* and *Lepidosteus* the radial elements exhibit a decided approximation to the condition of these structures in the more generalized Teleosts. They are trisegmental, each element consisting of an ossified dagger-shaped proximal segment, an hour-glass-shaped mesial segment also ossified, and a nodular cartilaginous distal segment. The various segments afford mutual support to one another, not by their parallelism and apposition, but by the articulation of the mesial and distal segments of one element with the proximal and mesial segments of that next succeeding. A marked reduction in the number of fin-rays has taken place, and each radial element has now but a single ray, which is cleft basally and clips the distal segment of its proper radial element; but from what has been said as to the articular relations of the segments of contiguous elements, it is obvious that two elements contribute directly or indirectly to the support of each ray. The dermal fin-rays are now the exclusive support of the externally visible portions of the fins, the radial elements having become deeply seated between the dorso-lateral muscles of opposite sides of the body—a position which they retain in the remaining Ganoids and in all Teleosts. Indications of suppression of segments of particular elements are not wanting, and, as in Elasmobranchs, they are characteristic of the more anterior or posterior of the supporting elements of the fins, which, in consequence, may become bisegmental or even unisegmental. The fact that in *Lepidosteus* the first and last of the radial elements of both the dorsal and anal fins support one or two rays, in addition to the single ray which normally belongs to each, is probably due to the concentration of certain rays which have lost their radial elements during the atrophy of a primitively more extensive fin, on the first and last of the persistent residue of the fin-supports. The presence of vestigial radial elements (*Amia*) between the dorsal and anal fins indicates the primitive continuity of these structures.

(3) The third type, represented by *Polypterus*, is of a singularly aberrant character. The simple bisegmental elements of the

more primitive anal fin cannot readily be compared with those of other Ganoids. The dorsal and ventral segments of each element may correspond to the proximal and mesial segments of other Ganoids, the distal segment having been suppressed, but it is by no means clear that this is the correct interpretation. I am inclined to think that the counterpart of this type of fin-support must be looked for in older and more primitive forms. Comparison with the simple bisegmental radial elements of the dorsal fins of such ancient Elasmobranchs as *Cladoselache* and *Pleuracanthus*, or of such Arthrodira as *Coccosteus*, reveals a very close agreement with *Polypterus*, and suggests that the latter has retained in its anal fin a more primitive type of fin-support than any living fish except, perhaps, the Marsipobranchs. Further indications of the primitive character of the anal fin of *Polypterus* are to be found in the absence of the characteristic articulation between contiguous radial elements which is so marked a feature in *Amia* and *Lepidosteus*, and in the fact that the dermal fin-rays are twice as numerous as their supporting elements.

The radial elements of the dorsal fin present a striking contrast to those of the anal fin. That their simple unsegmented condition is not due to the retention of a primitive character, but, on the contrary, is the result of specialization, is suggested by the size of the structures they support. The spines of the anterior part of the fin, and even the multiarticulate branched rays of the hinder part, are exceptionally massive, and the segmentation of the supporting elements would obviously detract somewhat from their value as skeletal supports for the former. Hence, whatever may have been the primitive condition of the fin-supports, and the probability is that they resembled those of the anal fin, it seems legitimate to infer that the reduction of each element to a single segment is correlated with their function as supports for exceptionally large dermal fin-rays. A precisely similar modification and reduction is frequently associated with the development of unusually large spines in many Teleosts *. But if this explanation be correct, it might reasonably be anticipated that fossil Crossopterygidæ with soft fin-rays would throw some light on the primitive character of the fin-supports in this group; but unfortunately the evidence available from this source, although not opposed to the suggestion, is by no means conclusive. In

* See also *Aulostoma chinense*, where a modification very similar to that referred to in *Polypterus* has taken place in the anterior dorsal fin.

Eusthenopteron Foordi, Whiteaves, the radial elements in both the dorsal and anal fins are apparently bisegmental, but the basal segments in each fin are confluent, although three distal segments are distinct and support the numerous fin-rays. In *Undina gulo*, Egerton, two radial elements are present in each fin, which are fused distally but distinct and divergent proximally; and in *Diplurus longicaudatus*, Newberry, the fin-supports of the two dorsal fins have fused into a single piece in each case, which dorsally supports the dermal fin-rays. The fin-supports of *Eusthenopteron Foordi* are obviously derived from a primitive bisegmental type; but it is equally clear in this species, as well as in *Diplurus* and *Undina*, that the structures in question have undergone considerable specialization in which concrescence has played an important part.

In several families of Physostomous Teleosts, viz., the Osteoglossidæ, Murænidæ, Esocidæ, Cyprinidæ, Salmonidæ, and possibly in others, more or fewer of the radial elements of both the dorsal and anal fins are trisegmental; and in this respect, as well as in the relations of the segments of contiguous elements for mutual support, these families more or less closely resemble the Ganoid genera *Amia* and *Lepidosteus*. Of the five families, the Osteoglossidæ and the Murænidæ are undoubtedly the most primitive in so far as the character of the fin-supports is concerned, and approach most closely to the two Ganoid genera. In the Murænidæ (*Conger* and *Anguilla*) all the radial elements are trisegmental; and there is no concentration of fin-rays on the first or last of the series, each element possessing only a single ray. In the Osteoglossidæ suppression has slightly modified certain elements to the extent that the last two in the dorsal and anal fins have lost their distal segments.

In the three remaining families there is a tendency to a variable reduction in the number of radial elements which retain the primitive trisegmental character, the reduction affecting the more anterior and posterior of the series, which in consequence become bisegmental or even unisegmental. The reduction in the case of the anterior elements is undoubtedly associated with the requirements of a firm support for the large and often spinose anterior dermal fin-rays; in the case of the posterior elements the reduction is clearly due to degeneration, and is invariably associated with the presence of feebly developed rays or their absence (e. g. *Barbus*). The extent to which reduction modifies

the character of the radial elements of different portions of the dorsal fin in these families may be represented in the following Table.

Name of Species.	Number of radial elements.	Trisegmental.	Bisegmental.	Unisegmental.
Esocidæ.				
Esox lucius	20	6–15	2–5, 16–20	1
Cyprinidæ.				
Barbus vulgaris ...	10	5–9	1–4	10
Cyprinus carpio ...	22	3–21	1–2	22
Salmonidæ.				
Coregonus pollan...	12	6–11	3–5	1–2, 12

The existence of trisegmental radial elements in Teleosts has not previously been recorded, at all events so far as I have been able to discover. The development of the radial elements has been studied by Harrison [3]; and from the results of his investigations in *Salmo salar* and *Carassius auratus* it would appear that each element first makes its appearance in the form of a somewhat curved cartilaginous rod or "Flossenstrahlträger," the convexity of which is directed forwards. "Schliesslich bildet sich aus dem undifferenzirten Gewebe am Ende jedes Flossenstrahlträgers ein kleiner kugelförmiger Knorpel, mit dem sich der Flossenstrahl eng verbindet. Jedes Flossenstrahlpaar umgreift die knorpelige Kugel mit ihrem centrale Ende, welches zu einem kurzen und beinahe horizontalen Fortsatz umgebogen ist, und zwei Gebilde vereinigen sich vollständig vermittelst eines starken Bindegewebes" (*l. c.* p. 521). No mention is made of mesial segments, although such segments are undoubtedly present in both the Salmonidæ and Cyprinidæ in the adult state, but it is probable that the omission is due to the fact that Harrison's investigations were principally directed to the origin and metameric relations of the fin-muscles, and ceased at a much earlier stage than that at which the radial elements attain their adult characters. As regards the origin of the mesial segments, two alternative methods may be suggested. It is of course possible that, like the distal segments, they owe their formation to the chondrification of indifferent connective tissue between the "Flossenstrahlträger" and the cartilaginous nodule representing the distal segment at a later stage; or it may be

that they result from secondary segmentation of the distal part of the "Flossenstrahlträger." The latter of the two suggestions seems the more reasonable; for the curvature of the "Flossenstrahlträger" is strongly suggestive of the similarly bent shape of an ordinary proximal and mesial segment taken together. It is nevertheless probable that the cutting-off of the mesial segment may in some cases precede ossification, while in others it may be the result of the appearance of a separate centre of ossification at the distal end of the "Flossenstrahlträger." *Lepidosteus* and *Amia* are, perhaps, examples of the former method, inasmuch as in these genera the cartilage-tipped mesial segments are separated by a very evident suture from the similarly tipped distal extremities of the proximal segments. On the other hand, in *Esox* (Pl. XXI. fig. 11), and possibly in other Teleosts with trisegmental elements, the second method has been the one adopted, the mesial segments in the more anterior radial elements of the dorsal fin being represented by small ossific centres in the unsegmented cartilaginous extremity of a backwardly curved "Flossenstrahlträger."

The existence of separable mesial segments in Teleosts, not only in the families above mentioned but also in certain Acanthopterygii, renders it possible to regard the radial elements of Teleosts as typically trisegmental, and therefore directly comparable with the corresponding structures in Ganoids (excluding *Polypterus*) and existing Elasmobranchs.

As regards the relative constancy of the three typical segments of a radial element, it seems reasonable to infer, from the order of their suppression, that not only in the families above mentioned, but in Teleosts generally, the proximal segment is the most constant, that the distal segment is next constant, while the mesial is apparently the least constant and that most likely to disappear first.

In the Physostome families the Siluridæ, Characinidæ, and the Clupeidæ the radial elements are either bisegmental or unisegmental, never, owing to the absence of a distinct mesial segment, trisegmental: very rarely is it the case, as in some Siluridæ (e. g. *Cnidoglanis*), that a functional dorsal fin has no radial elements but is supported solely by its fin-rays. In the Characinidæ (*Citharinus*) and the Clupeidæ (*Clupea*) all the radial elements in both fins are bisegmental, consisting of proximal and distal segments. In the Siluridæ (*Platystoma*, *Amiurus*), while the great majority of

the elements remain bisegmental, more or fewer of the anterior ones become specialized for the support of powerful defensive spines, and in consequence lose their distal segments and become unisegmental, as, for example, the first two elements of the dorsal fin. On the other hand, in the Gymnotidæ the distal segments are either entirely wanting or are represented by simple fibrous pads interposed between the fin-rays and the distal extremities of the proximal segments.

It is nevertheless interesting to note that in the Clupeidæ and Siluridæ, as in so many other Teleosts, the distal extremities of the proximal radial segments of the dorsal fin, with the occasional exception of the more anterior of the series, are produced obliquely upwards and backwards into well-marked postero-superior processes, which in their relations to the distal segments, as well as in their articulation with the proximal segments of the next succeeding elements, exhibit a striking resemblance to the mesial segments of *Amia* and *Lepidosteus* and of those Physostomi with trisegmental elements. There is, however, no evidence that these processes are mesial segments which have fused with the proximal segments, or that they can be looked upon in any other light than as modifications of the distal extremities of ordinary proximal segments that have taken the place of the missing mesial segments; and this conclusion is supported by the fact that in some Teleosts (e. g. *Regalecus*) similar processes, but antero-superior in position, may be developed from the distal ends of the proximal segments and exist in conjunction with ordinary postero-superior processes *. In the Characinidæ (*Citharinus*) these processes are entirely wanting, and the proximal segments derive mutual support from the simple apposition of their distal extremities. In the Gymnotidæ (*Gymnotus*) not only are postero-superior processes undeveloped, but the proximal segments have no articular relations, and except for their ligamentous connexion are quite distinct from one another †.

As regards the ossification of the radial elements, the proximal, and the mesial segments when present are invariably ossified:

* It is not altogether improbable, however, that a proximal segment and its postero-superior process may correspond to Harrison's "Flossenstrahlträger," and therefore represent an undivided proximo-mesial segment ossified continuously from a single centre.

† The proximal radial segments of the anal fin very generally possess oblique postero-inferior processes which are similar in their mutual relations to the postero-superior processes of the dorsal fin.

the distal segments are variable in this respect, and may either be simple cartilaginous nodules (*Esox*), or become ossified (*Cyprinus*, *Barbus*, *Osteoglossum*, *Citharinus*), in some (e. g. *Cyprinus*) from two lateral centres.

Lateral longitudinal ridges on the outer surfaces of the proximal radial segments are now generally present, as in most other Teleosts, and serve to increase the surface available for the origin of the erector and depressor muscles of the fin-rays.

In the Anacanthini, represented by the Gadidæ (*Gadus*, *Merluccius*) and the Pleuronectidæ (*Pleuronectes*), the radial elements, with the occasional exception of the last of the series, are bisegmental, mesial segments being invariably wanting. The persistence of simple nodular distal segments, usually cartilaginous, throughout the series, even in the anterior elements, is evidently associated with the absence of spinose fin-rays. In the Gadidæ the proximal segments possess well-developed postero-superior processes in the dorsal and postero-inferior processes in the anal fin, with the usual articular relations with the distal segments and with contiguous proximal segments. In the Pleuronectidæ these processes are wanting, the proximal segments being in simple parallel apposition.

In the Acanthopterygian Teleosts, as might be expected, there is a wide range of variation in the condition of the radial elements. The only families in which the trisegmental type occurs are the Berycidæ (*Holocentrum*), Percidæ (*Mesoprion*), and the Sphyrænidæ (*Sphyræna*). In *Holocentrum*, *all* the ray-bearing elements of the posterior non-spinose section of the dorsal fin, and, with the exception of the first three, all those of the anal fin are trisegmental. In *Sphyræna* only the last five of the soft portion of the dorsal fin and the last four of the anal fin are trisegmental; and in *Mesoprion* the last four of the posterior dorsal fin and the last three of the anal fin. The remaining elements of the posterior dorsal and the anal fins of the last two genera and the first three of the anal fin in *Holocentrum* are bisegmental, as also are those which support the anterior spinose section of the dorsal fin in all three genera *. In the remaining Acanthopterygii,

* It may be remarked that *Holocentrum* is a modern representative of one of the oldest families of existing Teleosts; and from this point of view the fact that the radial elements of the hinder section of the dorsal fin and the anal fin retain their primitive trisegmental character to a greater extent than in any other living Acanthopterygii is of considerable interest.

excluding the Blenniidæ, the supporting elements of the hinder soft-rayed portion of the dorsal fin and also those of the anal fin (if present) are bisegmental; and the same may be said of the fin-supports of the spinose portion of the dorsal fin in the Percidæ, Sparidæ, Scombridæ, and Carangidæ, and of the whole dorsal fin of the Trachypteridæ. On the other hand, in the Cottidæ, Mugilidæ, Labridæ, and Fistulariidæ the anterior spinose dorsal fin is supported by radial elements which consist only of proximal segments, and are therefore unisegmental. In the Blenniidæ the whole of the extensive dorsal fin is supported by unisegmental elements. As a rule, the posterior soft-rayed part of the dorsal fin and the anal fin more or less closely agree in the character of their radial elements; the Blenniidæ, in which the elements of the dorsal fin are unisegmental while those of the anal are bisegmental, being the only family in which there is any marked difference between the two series.

Indications of the suppression of segments are not wanting in fins in which the majority of the radial elements are either trisegmental or bisegmental: this is apparent, for example, in *Perca*, where the last three elements of the spinose part of the dorsal fin have lost their distal segments, and in *Aulostoma*, where the last two of the posterior dorsal fin are similarly modified.

In nearly all the Acanthopterygii the proximal radial segments of the dorsal and anal fins are furnished with postero-superior or postero-inferior processes with the usual articular relations: they are, however, usually wanting in the more anterior elements of each fin.

In the more typical Acanthopterygii, such as the Berycidæ, Percidæ (excluding *Mesoprion*), Sparidæ, and the Scombridæ, the postero-superior processes in the spinose part of the dorsal fin, and the distal radial segments which articulate with them, are laterally expanded and bent upwards so as to form sections of a continuous, medio-dorsal, bony groove for the reception of the spines when deflected. In the Cottidæ, where distal segments are wanting, the postero-superior processes are alone concerned in the formation of the groove. In others, as in the Blenniidæ, the groove is absent. Occasionally, through their considerable increase in length, the postero-superior and postero-inferior processes serve to connect together the otherwise widely separated radial elements which support externally distinct fins or finlets,

as is the case with the isolated dorsal and ventral finlets of *Scomber*. In the Trachypteridæ (*Regalecus*) only are the proximal radial segments provided with antero-superior processes either singly or in conjunction with postero-superior ones.

In the Lophobranchii, as represented by the Syngnathidæ (*Siphonostoma*), the radial elements of the dorsal fin are all bisegmental, consisting of proximal and distal segments only. The proximal segments are simple elongated ossicles, without lateral longitudinal ridges or postero-superior processes, and are in simple apposition by their cartilage-tipped distal extremities. The distal segments agree in number with the proximal, and are simple cartilaginous nodules connected with one another by ligament in a longitudinal series.

In the Plectognathi the radial elements are essentially similar in the single dorsal and the anal fin of the Gymnodontes (*Diodon*, *Tetrodon*, and *Orthagoriscus*), and in the posterior dorsal and anal fins of the Sclerodermi (*Balistes*, *Monacanthus*), but are modified by fusion, and in other respects, in the anterior dorsal fin of the two latter genera. In the Sclerodermi the cartilaginous distal extremities of the proximal radial segments, although in close apposition so as to form an even dorsal margin for articulation with the distal segments, are nevertheless distinct; in the Gymnodontes, on the contrary, the extremities fuse into a continuous margin of cartilage traversed by a longitudinal groove for articulation with the series of distal segments. In the Sclerodermi, and in *Tetrodon* among the Gymnodontes, the distal segments agree in number with the proximal; but in *Diodon* and *Orthagoriscus* the former are the more numerous, and agree numerically with the fin-rays they support. In the two last-mentioned genera the distal segments, instead of being small in size and cubical in shape, assume the form of elongated cartilaginous rods, a condition which exists in no other Teleosts. The Gymnodontes are also peculiar among Teleosts in that the vertebral extremities of the proximal radial segments are provided with cartilaginous epiphyses.

Vestigial radial elements in the form of slender rod-like ossicles, or flattened lamellar bony plates, are of frequent occurrence in Teleosts, and apparently represent persistent proximal segments which have lost their dermal fin-rays. Very often there is a single vestigial element immediately posterior to the last ray-bearing element of the dorsal fin (e. g. *Holocentrum*, *Mesoprion*, *Sphyræna*), and not infrequently a more or less extensive series

is to be found in front of the first. Thus in the latter position there may be only one vestigial element (e. g. *Perca*), or three (*Mesoprion*, *Pagellus*, *Caranx*), or seven (*Citharinus*) or eight (*Abramis*) ; and in a few instances the number may be so considerable as to extend the series to the posterior face of the skull, as, for example, where the numbers are seventeen (*Coregonus*), or eighteen (*Clupea*). In some instances such vestigial elements are interposed between the ray-bearing elements of fins which externally are discontinuous : thus, between the mesial and posterior dorsal fins of *Gadus æglefinus* there are three vestigial elements; between the anterior and posterior dorsal fins of *Scomber scomber* fifteen; and in a similar position in *Mugil capito* three. The presence of these ossicles must be regarded as indicating the existence of a primitively more extensive dorsal fin ; and in the case of *Scomber*, *Gadus*, and *Mugil* proves also the original continuity of fins which in the adult are distinct. No vestigial elements are ever present anterior to the first ray-bearing element of the anal fin, although somewhat rarely there may be one behind the last.

Radial elements are in ligamentous connexion with one another; and in the absence of definite articulations, *inter se*, this may be the only bond of union between them (e. g. *Cyclopterus*). Where the elements are trisegmental, a ligament (interossicular ligament) extends backwards from each distal segment to the mesial and distal segments of the next succeeding element. In the absence of a mesial segment, the postero-superior or postero-inferior process takes its place as a point of attachment for the ligament; and when both mesial and distal segments are wanting, the ligament extends between the distal extremities of successive proximal segments. In some genera the ossification of the ligaments, or of portions of them, may give rise to bony hook-like processes for articulation with the dermal fin-rays (*Holocentrum*, *Mugil*, *Anarrhichas*).

Relations of the various Segments of the Radial Elements to the Dermal Fin-rays in different Teleosts.

As in *Lepidosteus* and *Amia*, so in the majority of Teleosts, each element normally possesses only a single fin-ray ; but owing to the fact that the distal segments which directly support the fin-rays articulate not only with the mesial or, in their absence, the proximal segment of the same radial element, but also with the proximal segment of the next succeeding element, it is very

generally the case that two elements contribute directly or indirectly to the support of each ray. In certain families, however, as the result of the suppression of both mesial and distal segments, either in the entire dorsal fin or in the anterior section of it, the fin-rays become disassociated from their own proper elements, and are supported solely by the proximal radial segments immediately posterior to those to which they really belong (*e. g.* Blenniidæ, Labridæ). In only one or two families (*e. g.* Cyclopteridæ), and probably as the result of degeneration, are the fin-rays exclusively supported by their own proper radial elements. Evidence of the concentration of fin-rays is apparent in the dorsal and anal fins of most Teleostean Fishes. Thus, the first radial element of the dorsal fin in *Esox* and *Coregonus* supports two rays, of which the second is, without doubt, its proper ray; in *Barbus* and *Cyprinus* it supports three rays in addition to the fourth—the proper ray of this element. The corresponding radial element of the anal fin may also suport additional rays, as may the last element of both the dorsal and anal fins. In all these instances the explanation previously given in the case of *Amia* and *Lepidosteus* holds good. It is possible in those genera (e. g. *Citharinus*) where the first radial element of the dorsal fin possesses supernumerary rays or spines, and there are also vestigial elements anterior to it, that the additional rays pertain to certain of the hinder vestigial elements.

The mode of articulation of the dermal fin-rays with their supporting radial elements is subject to a wide range of variation in different Teleosts, and even in different portions of the same fin. The more characteristic articulations are, for the most part, well known to ichthyologists; but it is nevertheless worth while to summarize the part played by the different segments of the radial elements in their formation. Briefly, it may be said that the method of articulation is dependent upon (1) the *size* of the dermal fin-rays; (2) the extent and kind of movement which takes place between the rays and the radial elements; and (3) variations in the method by which similar results are produced in different groups of Fishes.

The simplest, and probably the more primitive method, occurs in such instances where, as in *Amia* and *Lepidosteus, Osteoglossum* and *Muræna*, the cleft base of each fin-ray merely embraces or clips the distal segment of its radial element. This method is characteristic of the soft multiarticulate variety of fin-ray, and is sometimes to be found throughout the whole extent

of a fin, not only in the genera above mentioned, but in the Pleuronectidæ, Gymnotidæ, Lophobranchii, and Plectognathi, and very generally also in the feebler rays which constitute the hinder part of the fin in such Teleosts as possess a distal series of radial segments. With an increase in the size of the soft fin-rays towards the central and anterior portions of a fin, the proximal extremities of the cleft base of a ray may become enlarged and terminate in two lateral basal condyles which acquire a definite articulation with facets on the anterior portion of the distal end of the next succeeding proximal segment, in addition to its normal relations with its own distal radial segment; while it may not infrequeutly be the case that a firmer connexion between the distal segment and its fin-ray is brought about, by the development of two in-growing tubercular or peg-like processes from the inner surfaces of the cleft base of a ray, which fit into corresponding sockets on the lateral surfaces of the distal segment (peg-and-socket joint), as, for example, in *Citharinus* and *Conger*. In the case of the spinose and often massive rays of the anterior portion of a fin, the methods of articulation are many and various. Excluding the Acanthopterygii and dealing first with the Physostomi, the base of a spine, by the secondary closure of the basal cleft, may become converted into a transversely extended condyle articulating, in the absence of a distal segment, with a suitably modified surface or groove on the distal extremity of the proximal radial segment, and, in addition, possessing also a "hook-link" or even a "chain-link" connexion with the same segment, as is the case, for example, with the defensive spines of many Siluridæ; or the spines, retaining their cleft bases, may simply clip the dorsal margin of the segment (*e. g.* the guard-spines of the Siluridæ); or, finally, their method of articulation may be precisely similar to that of the larger soft rays, as in the serrated defensive spines of *Cyprinus* and *Barbus*.

The most characteristic methods of connexion between the spinose rays and their radial elements are, however, the "chain-link" and "hook-link" articulations of the anterior dorsal fin of the Acanthopterygii.

"Chain-link" articulations may be formed in several ways:—

(*a*) By the formation of a hook-like bony process from the hinder margin of a distal radial segment, which extends backwards to a sutural or a firm ligamentous connexion with a bony tubercle on the distal end of the next succeeding proximal segment, the bony loop thus formed traversing a foramen in the

base of the spinose ray. As previously mentioned in the case of *Conger*, *Citharinus*, and *Holocentrum*, the hook-like process probably owes its formation to a further modification of the "peg-and-socket" method of articulation. Examples of this form of "chain-link" articulation are to be found in the Scombridæ, Percidæ, Berycidæ, and Sparidæ.

(*b*) The suppression of the series of mesial and distal segments and the extension of the bony tubercle already mentioned above in the form of a loop forwards and downwards to its fusion with the distal end of the same proximal segment at a point more anterior to its origin—the loop, as before, traversing a foramen in the base of the spine. In this case there can be little doubt that the loop owes its formation to the growth of the bony tubercle by the ossification of the interossicular ligament. The Mugilidæ and the Labridæ furnish examples of this variety of "chain-link."

(*c*) The ingrowth of tubercles from the inner surfaces of the basal halves of a cleft spine through the distal margin of a proximal segment and their subsequent mesial union. This method is probably due to a modification of the "peg-and-socket" joint, except that the ingrowing tubercles perforate the superior margin of a proximal radial segment instead of a distal segment. Examples of this method of articulation may be found in the anterior and usually supernumerary spinose rays of the dorsal or anal fins of the Percidæ (*Mesoprion*), Sparidæ (*Pagellus*), Scombridæ (*Scomber*), Carangidæ (*Caranx*), and Mugilidæ (*Mugil*). It is possible, however, in some cases, as in the particular instance of the second and third anal spines of *Holocentrum*, that the ossification of the interossicular ligament, by which the distal radial segments are connected with their own and with immediately adjacent proximal segments, may contribute to the formation of the bony loops.

The "hook-link" is, so to speak, an incipient stage in development of a form of chain-link (*b*), and is associated with the suppression of both the mesial and radial segments and the growth of the bony tubercle above mentioned in the form of a hook through a foramen in the base of a fin-ray, but without again uniting with the proximal segment to which it belongs. In this form of joint, as previously pointed out, each ray or spine is solely supported by the proximal radial segment immediately posterior to that to which it rightly pertains, as, for example, in the dorsal fin of the Blenniidæ.

In the Sphyrænidæ and the Cottidæ may be found examples of peculiar methods of articulation which are different from any of those hitherto considered. In the former of the two families the distal radial segments have no hook-like processes, and the base of each spine forms a transversely elongated condyle which fits into a corresponding groove between the distal segment of one radial element and the adjacent distal end of the next succeeding proximal segment. The latter family exhibit a somewhat similar method of articulation, except that in the absence of distal segments the hinder margin of a postero-superior process forms the anterior boundary of the articular groove for reception of the condylar base of the spinose fin-ray.

From what has been said as to the articular relations of the fin-rays and their supporting radial elements, it is obvious that the development of spinose rays in Teleosts is one of the factors concerned in the reduction of typically trisegmental elements to the bisegmental or unisegmental condition. The existence of trisegmental elements is always associated with the support of soft multiarticulate rays, and there is not a single Teleost in which such elements support spines. And even where the majority of the elements are bisegmental, as in the anterior dorsal fin of the Siluroids, the development of special defensive or "guard-spines" is associated with the reduction of their supports to the unisegmental type. An increase even in the size of the soft rays is occasionally attended by a reduction from the trisegmental to the bisegmental condition, as may be seen in the anterior elements of the first dorsal fin in several of the Cyprinoids. It is, moreover, in the anterior spinose dorsal fin of the Acanthopterygian Teleosts that the reduction reaches its maximum, extending, as it does in whole families, to the existence of simple unisegmental elements. It is nevertheless certain that increase in the growth of spinose rays is not the only factor in this process of reduction. The Gymnotidæ have soft rays combined with unisegmental elements. The large anterior dorsal spines of the Percidæ, Berycidæ, and Sparidæ are supported by bisegmental elements, but the relatively much less massive spines of the Cottidæ and Mugilidæ by unisegmental elements. The development of spines may have been one of the factors in reduction, but there is also little doubt that the increasing specialization of existing Teleosts and the gradual loss of many of their more primitive characters are contributory causes.

IV. REFERENCES.

1. PARKER, T. J.—"Studies in New Zealand Ichthyology. i. On the Skeleton of *Regalecus argenteus*." Trans. Zool. Soc. vol. xii. pt. 1, 1886.
2. RYDER, J. A.—"On the Origin of Heterocercy and the Evolution of the Fins and Fin-rays of Fishes." United States Commission of Fish and Fisheries: Commissioner's Report for 1884, Part 12.
3. HARRISON, R. G.—"Die Entwicklung der unpaaren und paarigen Flossen der Teleostier." Archiv für mikr. Anatomie, Bd. xlvi. 1895; also Johns Hopkins University Circulars, vol. xiii., no. iii., 1894.
4. DEAN, BASHFORD.—Fishes, Living and Fossil. Columbia University Biological Series, iii., 1895.
5. THACKER, J. K.—"Median and Paired Fins. A Contribution to the History of the Vertebrate Limbs." Trans. Connecticut Academy, vol. iii., 1877.
6. MIVART, ST. G.—"Notes on the Fins of Elasmobranchs, with considerations on the Nature and Homologues of Vertebrate Limbs." Trans. Zool. Soc. vol. x., 1878.
7. FRANQUE, HENRICUS.—Amiæ Calvæ anatomiam descripsit tabulaque illustravit. Berlin, 1847.
8. SHUFELDT, R. W.—"The Osteology of *Amia calva*." Extracted from the Annual Report of the Commissioner of Fish and Fisheries for 1883. Washington, 1885.
9. McMURRICH, J. P.—"Contributions to the Anatomy of *Amiurus*." Toronto, 1884. Reprinted from Proc. Canadian Institute, (n. s.) vol. ii., 1884.

9 *a*. GÜNTHER, A.—Deep-Sea Fishes. 'Challenger' Reports, vol. xxii.

10. SÖRENSEN, W.—Om Lydorganer hos Fiske. Copenhagen, 1884.
11. DEAN, BASHFORD. Journ. Morph. vol. ix. p. 87; *cf.* also Natural Science, vol. viii. p. 245.
12. WOODWARD, A. S.—British Museum Catalogue of Fossil Fishes, vol. ii., 1891.
13. WELLENBERGH, P. H. J.—Observationes Anatomicæ de *Orthagoriscus mola*. 1840.
14. CLELAND, J.—"On the Anatomy of the Short Sun-fish (*Orthagoriscus mola*)." Nat. Hist. Review, vol. ii. 1862, p. 170.

EXPLANATION OF THE PLATES.

[Unless otherwise stated the figures are natural size.]

Plate XXI.

Fig. 1. *Polyodon folium.* Radial elements of the dorsal fin.
2. *Amia calva.* Radial elements of the central portion of the dorsal fin.
3. *Lepidosteus osseus.* Radial elements of dorsal fin.
4. *Polypterus bichir.* Two radial elements, with their finlets and spines, from anterior part of dorsal fin.
5. ,, ,, Two similar radial elements from posterior part of dorsal fin (supra-caudal fin).
6. ,, ,, Radial elements of anal fin.
7. *Osteoglossum formosum.* Five radial elements from central portion of dorsal fin, with four fin-rays. Twice natural size.
8. ,, ,, Four radial elements of anal fin and four fin-rays. Twice nat. size.
9. *Conger conger.* Four radial elements of dorsal fin.
10. ,, ,, Distal radial segment and its "peg-and-socket" articulation with a fin-ray.
11. *Esox lucius.* Radial elements of dorsal fin and their fin-rays.
12. *Barbus vulgaris.* Radial elements of dorsal fin and fin-rays.
13. ,, ,, Radial elements of anal fin and fin-rays.
14. *Platystoma tigrinum.* Radial elements of dorsal fin and their fin-rays.
15. ,, ,, Dorsal view of anterior radial elements.
16. ,, ,, Four radial elements of anal fin.
17. *Citharimus Geoffroyi.* First four radial elements of dorsal fin.
18. ,, ,, Dorsal view of first three radial elements, showing mode of articulation of fin-rays with distal radial segment. Twice nat. size.

Plate XXII.

Fig. 19. *Gymnotus electricus.* Four radial elements of anal fin.
20. *Pleuronectes platessa.* Five radial elements of dorsal fin.
21. *Holocentrum spiniferosum.* The first four and the last eighteen radial elements of the dorsal fin.
22. ,, ,, Dorsal view of four radial elements from anterior section of dorsal fin, to show mode of formation of the "chain-link" articulation and the dorsal groove.
23. ,, ,, Radial elements of anal fin.
24. *Mesoprion gembra.* The first four radial elements of the dorsal fin.
25. ,, ,, Three radial elements from the non-spinose posterior section of the dorsal fin.

PLATE XXIII.

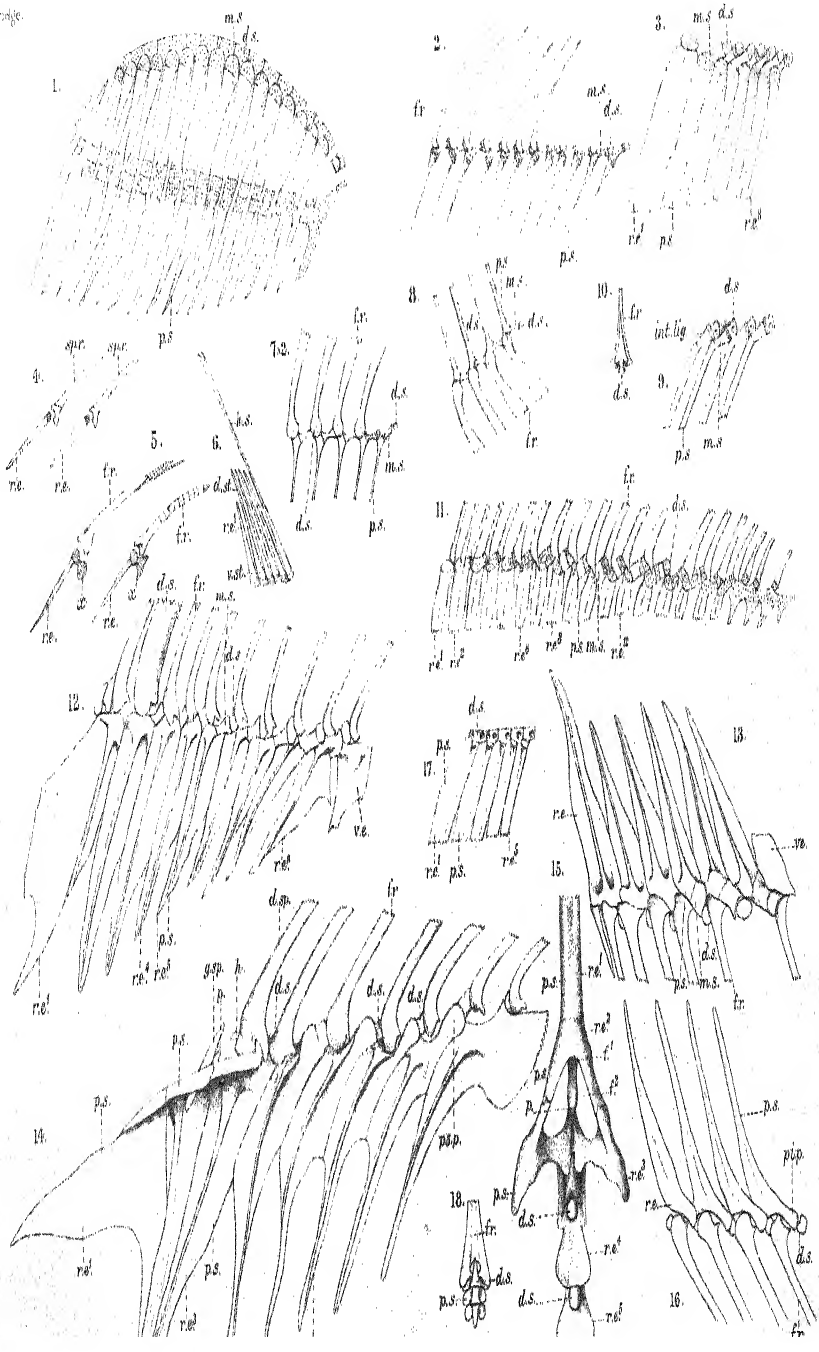
Fig. 26. *Mesoprion gembra.* First four radial elements of anal fin.
27. *Sphyræna Commersonii.* Six radial elements of anterior dorsal fin.
28. ,, ,, Dorsal view of three elements from the same fin, and one spinose ray.
29. *Trigla gurnardus.* Dorsal view of four radial elements from anterior spinose portion of dorsal fin.
30. *Mugil capito.* Four radial elements of anterior dorsal fin.
31. *Anarrhichas lupus.* Four elements from dorsal fin and one fin-ray.
32. ,, ,, Four radial elements from anal fin. Half nat. size.
33. *Pseudoscarus superbus.* The sixth to the eleventh (inclusive) radial elements of the dorsal fin.
34. *Balistes capriscus.* Radial elements from the central portion of the posterior dorsal fin. Enlarged.
35. *Tetrodon immaculatus.* Radial elements of dorsal fin.
36. ,, ,, Radial elements of anal fin.
37. *Diodon hystrix.* Radial elements of dorsal fin.
38. ,, ,, Vertical section of a radial element and its fin-ray, to show the relations of a fin-ray to its distal radial segment, and the mode of articulation between the distal and proximal segments.

Reference Letters.

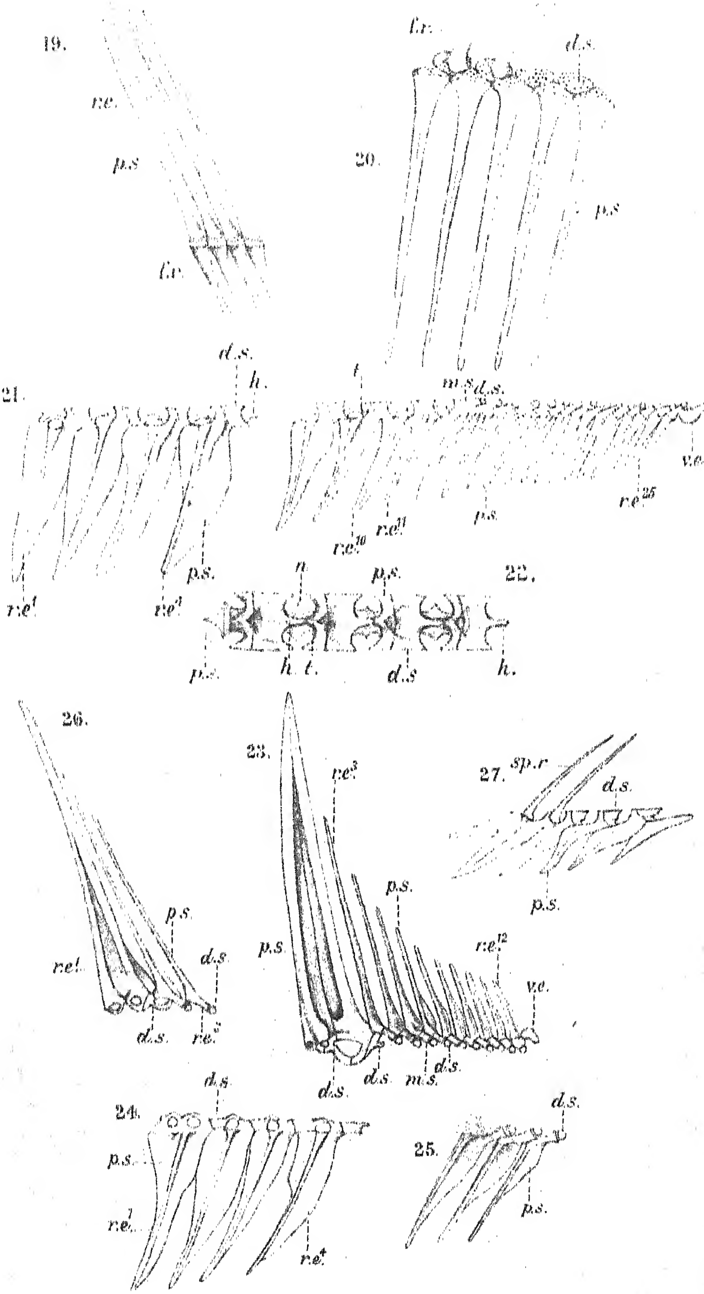
d.s. Distal segment of a radial element.
d.sp. Defensive spine.
d.st. Dorsal radial segment (anal fin of *Polypterus*).
f. Foramen for the passage of the muscles of fin-rays.
fc. Articular facet.
f.r. Fin-ray.
g.sp. Guard-spine.
h. Hook-like process.
h.s. Hæmal spine.
int.lig. Interossicular ligament.
n. Notch for passage of muscles of fin-rays.
m.s. Mesial segment of a radial element.
p.s. Proximal segment of a radial element.
pi.p. Postero-inferior process.
ps.p. Postero-superior process.
r.e. Radial element.
r.e.^{1}, *r.e.*^{2}, and so on. First, second, and other radial elements.
sp.r. Spinose ray.
v.e. Vestigial radial element.
v.st. Ventral radial segment (anal fin of *Polypterus*).

[The reference letters are uniform throughout.]

Bridge.

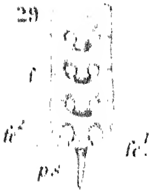


1.
2.
3.
4.
5.
6.
7a.
8.
9.
10.
11.
12.
13.
14.
15.
16.
17.
18.
m.s.
d.s.
p.s.
f.r.
r.e.
spr.
d.st.
v.st.
h.s.
int.lig.
v.e.
d.sp.
g.sp.
ps.p.
pt.p.

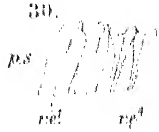

19.
r.e.
p.s
f.r.
f.r.
d.s
20.
p.s
21.
d.s.
h.
t
m.s.
d.s.
v.e.
r.e[25]
p.s.
r.e[11]
r.e[10]
p.s.
r.e[1]
r.e[7]
n
p.s.
22.
p.s.
h.
t.
d.s
h.
26.
23.
r.e[3]
27.
sp.r
d.s.
p.s.
p.s.
p.s.
r.e[12]
p.s.
r.e.[1]
d.s
v.e.
d.s.
r.e.[2]
d.s.
d.s.
m.s.
d.s.
d.s
24.
d.s.
25.
p.s.
r.e.[1]
p.s.
r.e.[4]

28.

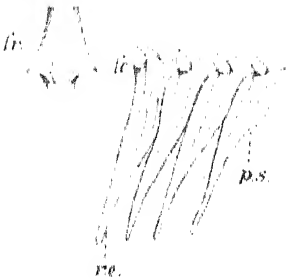
29



30.

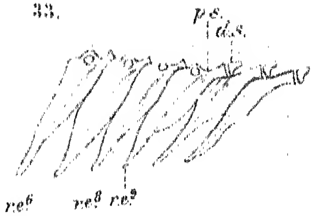


31

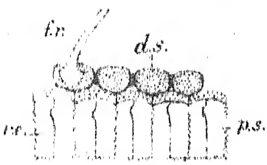


32.

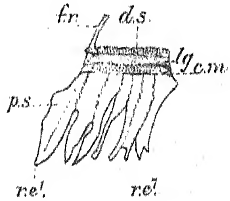
33.



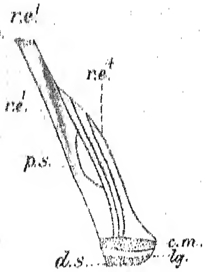
34



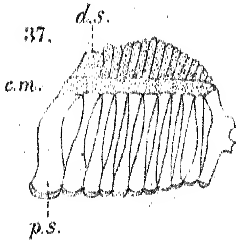
35.



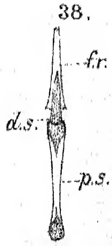
36.



37.



38.



INDEX.

[Synonyms and native names are printed in italics. A star is added to names which appear to be used here for the first time.]

Abramis, 595.
brama, 549.
Acanthopterygii, 530, 560, 569, 593, 597.
Acanthoscelio, *Ashm.*, 218.
Acarina, 39.
Acerota, *Förster*, 233.
confusa, *Ashm.* *, 233.
Acipenser, 536-538, 585.
sturio, 534.
Acipenseridæ, 530, 534.
Acoloides, *Howard*, 214.
fascipennis, *Ashm.* *, 214.
ochraceus, *Ashm.* *, 214, 215.
subfuscus, *Ashm.* *, 214, 215.
Acrocormus, *Förster*, 155.
megastigmus, *Ashm.* *, 155.
Acroperus, 2.
Acrydium, *Geoffr.*, 281.
peregrinum, *Oliv.*, 281.
tataricum, 281.
Ademon, *Hal.*, 133.
Adesmia acervata, *Klug*, 290.
assimilis, *Gahan* *, 290.
austera, *Baudi*, 290.
cancellata, *Klug*, var., 289.
interrupta, *Klug*, 289.
lacunosa, *Klug*, 289.
tuberculifera, *Gahan* *, 289.
Æluroidea, dentition of, 461, 462, 463.
Ænasius, *Walk.*, 60, 88.
hyettus, *Walk.*, 60, 89.
Æschna, 413; rectal gills of, 413.
Agathidinæ, 58, 128.
Agathis, *Latr.*, 128.
pectoralis, *Ashm.* *, 129.
rubricinctus, *Ashm.* *, 128.
Agenia, *Schiödte*, 429.
Aglaotoma, *Förster*, 63, 66.
basalis, *Ashm.* *, 63, 64, 65.
longicornis, *Ashm.* *, 63, 65.
pallida, *Ashm.* *, 63, 64.
variabilis, *Ashm.* *, 63, 64, 65.
Allman, Prof. G. J., Note on the Formation of the Epiphragm of *Helix aspersa*, 517-520.
Alysia, *Latr.*, 58.
analis, *Cr.*, 58.
Alysidium Lafontii, ftnote 267.
Alysiinæ, 58, 137.
Amauris, 347.
dominicanus, 343, 345, 348.
echeria, 343, 345.
egialea, 343, 348.
Amblyaspis, *Förster*, 233, 234.
nigricornis, *Ashm.* *, 234.
triangularis, *Ashm.* *, 233.
verticillatus, *Ashm.* *, 234, 235.
xanthopus, *Ashm.* *, 234, 236.
Amia, 52, 53, 538, 544, 545, 587, 588, 590, 591, 595, 596.
calva, 537.
Amiidæ, 530, 537.
Amiurus, 553, 554, 555, 590.
catus, 550, 554.
Amphipnous, 53, 54.
chuchia, 54.
Amphitherium, 474.
Prevostii, 474, 477.
Anacanthini, 530, 558, 592.
Anarrhichas, 575, 595.
lupus, ftnote 572, 573, 602.
Anderson, Dr. John, Scorpions obtained in Egypt and the Soudan by (R. I. Pocock), 299.
Androctonidæ, 303.
Androctonus, 303.
macrocentrus, Hempr. & Ehrenb., 300.
thebanus, Hempr. & Ehrenb., 300.
(Leiurus) *leptochelys*, Hempr. & Ehrenb., 299.
(——) *quinquestriatus*, Hempr. & Ehrenb., 299.
Anectclis, sp., *read* Anectoclis rufipes, *How.*, 77, 254.
Anectoclis, *Förster*, 77.
rufipes, *How.* *, 77, 254.

Anepisceptus horridus, *Burm.*, 280, 282.
Anguilla, 588.
anguilla, 545.
Anilocra, 338.
Anisolabis, *Fieber*, 521, 525.
littorea, *White*, 526.
occidentalis, *Kirby* *, 525, 529.
Anopedias, *Förster*, 239.
conica, *Ashm.* *, 239.
error, *Fitch*, 240.
Anozus, *Förster*, 179.
Ant, Umbrella, 406.
Anteris, *Förster*, 217, 227.
rufipes, *Ashm.* *, 227.
Anthia duodecimguttata, *Bon.*, 286.
Antrocephalus, *Kirby*, 59, 81.
punctigerus, *Fabr.*, 59, 81.
Ants, On a remarkable use of, in Asia Minor, by R. Morton Middleton, Jr., 405.
Aortic-Arch System of *Saccobranchus fossilis*, by R. H. Burne, 48–55.
Apachys, *Serv.*, 521, 522.
Beccarii, *Dubrony*, 522.
Pascoei, *Kirby* *, 521, 529.
Apegus, *Förster*, 217.
Aphænogaster barbara, *Linn.*, 280, 283.
Aphelininæ, &c., of the Island of St. Vincent, Report on the (L. O. Howard), 56, 79, 97.
Aphidiinæ, 137.
Apiopterina Orbignii, *Zborzewski*, 515.
Apterygida Erichsoni, *Dohrn*, 529.
Arachnida and Myriopoda of Bent's Expedition to the Hadramaut, South Arabia, by R. I. Pocock, 292–297.
Araneæ (Spiders), 296.
Araneidæ, 38.
Arctoidea, dentition of, 461, 462, 463.
Arthrodira, 585.
Ascirba, Cam., 86, 87.
Asellus, 32.
Ashmead, W. H., Report on the Parasitic Cynipidæ, part of the Braconidæ, the Ichneumonidæ, the Proctotrypidæ, and part of the Chalcididæ, of the Island of St. Vincent, Part I. 61; Part II. 108; Part III. 188.
——, Report upon the Parasitic Hymenoptera of the Island of St. Vincent, *see* Riley, C. V., 56–254.
Ashmeadia, *How.*, 61, 143, 146.
abnormicornis, *Ashm.* *, 143, 145.
insularis, *Ashm.* *, 143, 144.
megastigma, *Ashm.* *, 144, 145.
pallidipes, *Ashm.* *, 144.
pulchra, *Ashm.* *, 144, 145.
Aspicera *bifoveolata*, Cr., 58, 78.
rufipes, Cr., 78.
Aspongopus viduatus, *Fabr.*, 280, 283.
Astrorhizidæ, On a new Genus of Foraminifera of the Family, by A. Vaughan Jennings, 320–321.
Atta, *Fabr.*, 406.
cephalotes, *Linn.*, 406.
Atypus, 44.
Aulostoma, 576, 593.
chinense, 576, ftnote 587.
Aulostomella dorsigera, *Costa*, 515.
pediculus, *Alth*, 510.
Azemiops Feæ, *Boul.*, 121.

Bacillus ægyptiacus, Westw., 281.
Bacteria ægyptiaca, Gray, 281.
Bæoneura, *Förster*, 217.
Balistes, 580, 594.
capriscus, 578, 579, 602.
vetula, 578.
Barbus, 588, 592, 596, 597.
vulgaris, 547, 589, 601.
Baryconus, *Förster*, 216.
Baryscapus, *Förster*, 182.
Bent's Expedition to the Hadramaut, South Arabia, Reports on, 279–299.
Bephrata, *Cam.*, 146.
cultriformis, *Ashm.* *, 146.
Bernard, H. M., On the Spinning-Glands in *Phrynus*; with an Account of the so-called "Penis" and of the Morphology of the Operculum, 272–278.
Berycidæ, 530, 560, 592, 593, 598, 599.
Beryx decadactylus, *Cuv. & Val.*, ftnote 531, 563.
Bethylinæ, 188, 192.
Bingham, Lt.-Col. C. T., On some Exotic Fossorial Hymenoptera in the Collection of the British Museum, with Descriptions of New Species and of a New Genus of the Pompilidæ, 422–445.
Blacinæ, 131.
Blacus, *Nees*, 131.
rubriceps, *Ashm.* *, 131.
Blastophaginæ, 59.
Blatta germanica, ftnote 411.
Blattidæ, 279, 281.
Blenniidæ, 530, 573, 593, 596, 598.
Bolina, 339.
Bosmina, 2, 4.
Botellina, 320.
labyrinthica, *Brady*, 320, 321.
Brachycerus sp., 290.
Brachylabis, 521.
Brachylaimus, 323.
Bracon, *Fabr.*, 108.
femoratus, *Ashm.* *, 109, 112.
flavomaculatus, *Ashm.* *, 109, 111.
maculiceps, *Ashm.* *, 109, 111.

Bracon niger, *Ashm.* *, 109.
Sancti-Vincenti, *Ashm.* *, 109, 112.
seminiger, *Ashm.* *, 109, 110.
vulgaris, *Ashm.* *, 109, 112.
xanthospilus, *Ashm.* *, 109, 110.
Braconidæ, Report on, of the Island of St. Vincent (W. H. Ashmead), 108–138.
Braconinæ, 108.
Bridge, Prof. T. W., The Mesial Fins of Ganoids and Teleosts, 530–602.
Bryozoa, On Mediterranean and New-Zealand Reteporæ and a Fenestrate, by A. W. Waters, 255–271.
Bugula reticulata, 267.
Buprestidæ, 287.
Burne, R. H., On the Aortic-Arch System of *Saccobranchus fossilis*, 48–55.
Butheolus, 316.
thalassinus, *Sim.*, 295, 316.
Buthidæ, 303.
Buthus, 307.
acuto-carinatus, *Simon*, 292, 300, 316.
alticola, *Pocock* *, 302, 315.
anthracinus, *Pocock* *, 294, 295, 315.
arenicola, Sim., 300.
Benti, 316.
dimidiatus, *Simon*, 292, 293, 294, 300–302, 316.
europæus, *Linn.*, 299.
Jayakari, *Pocock* *, 300, 315.
judaicus, 302.
leptochelys, *Hempr. & Ehrenb.*, 299, 300, 307.
quinquestriatus, *Hempr. & Ehrenb.*, 292, 299.
scaber, *Hempr. & Ehrenb.*, 293.
villosus, Simon, 311.
Butler, A. G., An Account of the Butterflies of the Genus *Charaxes* in the Collection of the British Museum, 348–404.

Caberia, 263.
Cacus, *Riley*, 217, 226.
insularis, *Ashm.* *, 226, 227.
laticinctus, *Ashm.* *, 226, 227.
Callichthys, 55.
Calliplœa Hopfferi, *Felder*, 342.
Calliscelio, *Ashm.*, 216, 223.
laticinctus, *Ashm.* *, 223.
Caloteleia, *Westw.*, 216, 218.
ænea, *Ashm.* *, 218, 219.
elongata, *Ashm.* *, 218, 219.
maculipennis, *Ashm.* *, 218, 221.
ocularis, *Ashm.* *, 218, 220.
Caloteleia punctata, *Ashm.* *, 218, 221.
puncticeps, *Ashm.* *, 218, 219.
Calyostichus, *Mayr.*, 152.
auratus, *Ashm.* *, 152.
Calyptinæ, 131.
Calyptus, *Haliday*, 131.
thoracicus, *Ashm.* *, 131.
Camponotus, 405.
Campoplex, *Grav.*, 139.
meridionalis, *Ashm.* *, 139.
Canidæ, On the Tooth-genesis in the, by Dr. H. W. Marett Tims, 445–480.
Canis anthus, 467, 468; dentition of, 467, 468.
aureus, 454; dentition of, 467.
Azaræ, 467; dentition of, 467.
cancrivorus, 467; dentition of, 467.
familiaris, 447, 453; dentition of, 447–455.
lagopus, 468; dentition of, 468.
littoralis, 468; dentition of, 468.
magellanicus, 467; dentition of, 467.
niloticus, 468; dentition of, 468.
virginianus, *Mivart*, 468; dentition of, 468.
Canthocamptus, 18.
minutus, *O. F. M.*, 18.
Carabidæ, 286.
Carangidæ, 530, 569, 593, 598.
Caranx, 569, 595, 598.
georgianus, 569.
Carassius auratus, 589.
Carnivora, dentition of, 459; variation of teeth of, 461.
Carpenteria, 317–319.
rhaphidodendron, *Möb.*, 317.
Catharsius inermis, *Casteln.*, 287.
Catolaccus, *Thomson*, 60, 163.
helice, *Walk.*, 60, 163.
pallipes, *Ashm.* *, 163.
vulgaris, *Ashm.* *, 163, 164.
Cellepora, 499.
Cellulariidæ, ftnote 267.
Cephalomyia maculata, *Wiedem.*, 280, 285.
Cerambycidæ, 291.
Ceranisus, *Walk.*, 182.
Ceraphron, *Jurine*, 198.
fummipennis [*read* fumipennis], *Ashm.* *, 198, 199, 200.
meridionalis, *Ashm.* *, 199, 200.
Sancti-Vincenti, *Ashm.* *, 198, 199.
solitarius, *Ashm.* *, 199, 200.
Ceraphroninæ, 198.
Ceratacis, *Thoms.*, 236.
Ceratodus, 51.
Ceratoneura, *Ashm.* *, 178.
pallida, *Ashm.* *, 179.
petiolata, *Ashm.* *, 179.

Cerchysius, *Westw.*, 86, 87.
pulchricornis, *How.* *, 87.
terebratus, *How.* *, 87, 88.
urocerus, *Dalm.*, 86.
Coriodaphnia, 2.
Ceropales, *Latr.*, 425, 430.
pernix, *Bingh.* *, 425.
Cestracion francisci, *Girard*, 325.
galeatus, *Günther*, 325, 326, 327, 328, 329.
japonicus, *Macleay*, 325.
Philippi, *Schneider*, 326, 327, 328, 329.
zebra, *Gray*, 325.
Cetonia (Pachnoda) histrio, *Fabr.*, 287.
Chalcididæ, Report on, of the Island of St. Vincent (W. H. Ashmead), 143–188.
——, of the Subfamilies Chalcidinæ, &c. of the Island of St. Vincent, Report on the (L. O. Howard), 79–108.
Chalcidinæ, &c., of the Island of St. Vincent, Report on (L. O. Howard), 79–108.
Chalcis, *Fabr.*, 59.
annulatus, *Fabr.*, 59, 80.
fasciata, Oliv., 79.
punctigera, Fabr., 81, 82.
Chalcura, *Kirby*, 85.
americana, *How.* *, 85.
Chanos salmoneus, 53.
Chapman, F., and T. Rupert Jones, On the Fistulose Polymorphinæ and on the Genus *Ramulina*, 496–516.
Characinidæ, 530, 556, 590.
Charaxes, An Account of the Butterflies of the Genus, in the Collection of the British Museum, by A. G. Butler, 348–404.
Charaxes achæmenes, *Felder*, 356.
affinis, *Butler*, 391, 396, 397.
——, var. demonax, *Felder*, 396.
agabo, *Distant*, 371.
agna, *Moore*, 390.
agrarius, Swinh., 382.
albanus, *Röber*, 385.
alladinis, *Butler*, 358, 360, 361.
alladinis, Dewitz, 362.
alphius, *Staud.*, 384.
Ameliæ, *Doumet*, 374.
amycus, *Felder*, 397.
analava, *Ward*, 369.
andara, *Ward*, 351.
andranodorus, *Mabille*, 351.
——, var. zoippus, *Mabille*, 351.
andriba, *Ward*, 369.
antamboulou, *Lucas*, 368.
anticlea, *Drury*, 364.
Antonius, *Semper*, 389.
argynnides, *Westw.*, 371.
aristogiton, *Felder*, 397.
Charaxes arja, *Felder*, 384.
aruanus, Butler, 397.
athamas, *Drury*, 382, 383, 384, 386.
——, var. attalus, *Felder*, 383, 384.
——, var. samatha, *Moore*, 383, 384.
attalus, *Felder*, 383.
attila, *H. Grose Smith*, 387.
azota, *Hewits.*, 365.
Balfouri, *Butler*, 348, 400.
Baumanni, *Rogenh.*, 362, 363.
baya, *Moore*, 391, 396.
bayula, *Staud. in litt.*, 391.
Bernardus, *Fabr.*, 392, 393.
betanimena, *Lucas*, 369, 370.
betsimiseraka, *Lucas*, 370, 371.
bharata, *Felder*, 382.
bipunctatus, *Rothsch.*, 378.
Bohemani, *Felder*, 378.
borneensis, *Butler*, 394.
Boueti, *Feisth.*, 367.
brennus, Felder, 397.
brutus, *Cramer*, 350.
bupalus, *Staud.*, 394.
candhis, *Hewits.*, 399.
callielea, *H. Grose Smith*, 365.
candiope, *Godart*, 365, 367, 368.
caphontis, *Hewits.*, 388.
Carteri, *Butler*, 361.
castor, *Cramer*, 353.
——, var. flavifasciatus, *Butler*, 353.
cedreatis, *Hewits.*, 361.
chiron, *Staud.*, 359.
cimon, *Felder*, 395, 396.
cimonides, *Rothsch.*, 395.
cinadon, Hewits., 351.
cithæron, *Felder*, 375.
clitarchus, *Hewits.*, 388.
clitiphron, Oberth., 381.
cognatus, *Vollenh.*, 386.
concha, Vollenh., 379.
coniger, *Butler* *, 403.
corax, *Felder*, 391.
Cowani, *Butler*, 368.
cynthia, *Butler*, 366.
decius, *Cramer*, 403.
delphis, *Doubl.*, 379.
desa, *Moore*, 397.
Dewitzi, *Butler*, 360, 362, 363.
Distanti, *Honr.*, 398.
dolon, *Westw.*, 379.
Druceanus, *Butler*, 351.
Durnfordi, *Distant*, 349, 389.
echo, *Butler*, 357.
Ehmckei, *Dewitz*, 369, 370.
ephyra, *Godart*, 357, 359, 361, 363.
epigenes, *Godm. & Salv.*, 388.
epijasius, *Reiche*, 355.
etesipe, *Godart*, 366, 399.
ethalion, *Boisd.*, 357, 360, 362, 363.

Charaxes ethalion, var. Baumanni, *Rogenh.*, 362.
etheocles, *Cramer*, 358, 362.
eudamippus, *Doubl.*, 380.
——, var. mandarinus, *Felder*, 381.
——, var. thibetanus, *Oberth.*, 381.
eudoxus, *Fabr.*, 349, 352.
eupale, *Drury*, 378.
euryalus, *Cramer*, 389.
Everetti, *Rothsch.*, 349, 389.
fabius, *Fabr.*, 356.
falcata, *Butler*, 402.
fallax, *Röber*, 385.
——, var. javanus, *Röber*, 385.
fervens, *Butler* *, 396.
flavifasciatus, *Butler*, 353, 354.
Fruhstorferi, *Röber*, 383.
fulvescens, *Auriv.*, 401.
gabonica, *Crowley*, 381.
galaxia, *Butler*, 387.
ganymedes, *Staud.*, 385, 386.
ganymedes, Leech, 380.
georgius, *Staud.*, 391.
gilolensis, *Butler*, 387.
Guderiana, *Dewitz*, 358.
hadrianus, *Ward*, 381.
hamasta, *Moore*, 382.
hamatus, *Dewitz*, 372.
hannibal, *Butler*, 357.
Hansalii, *Felder*, 353.
harmodius, *Felder*, 398.
harpagon, *Staud.*, 398.
harpax, *Felder*, 390.
hebe, *Butler*, 382, 385.
——, var. ganymedes, *Staud.*, 385.
hemana, *Butler*, 391.
heracles, Röber, 385.
hierax, *Felder*, 390.
Hildebrandti, *Dewitz*, 363.
hindia, *Butler*, 393.
hipponax, *Felder*, 393.
——, var. hindia, *Butler*, 393.
——, var. jalinder, *Butler*, 393.
Hollandi, *Butler*, 362.
homerus, *Staud.*, 371.
Homeyeri, *Dewitz*, 370.
imna, *Butler*, 390.
imperialis, *Butler*, 374.
jahlusa, *Trimen*, 371, 372.
jalinder, *Butler*, 393.
jalysus, *Felder*, 382.
jason, *Linn.*, 355.
javanus, *Röber*, 385.
jocaste, *Boisd. MS.*, 356.
jupiter, *Butler*, 387.
——, var. attila, *H. Grose Smith*, 387.
kaba, Kheil, 385.
Kadenii, *Felder*, 386.
Kahldeni, *Dewitz*, 370.
Charaxes kahruba, *Moore*, 398.
khasianus, *Butler*, 394.
khimalara, *Butler*, 394, 395.
Kirkii, *Butler*, 358.
lactetinctus, *Karsch*, 349, 365.
lampedo, *Hübner*, 356, 357.
laodice, *Drury*, 372, 373.
Lasti, *H. Grose Smith*, 367.
latona, *Butler*, 396, 397.
Layardi, *Butler* *, 395, 396.
leoninus, *Butler*, 372.
lichas, *Doubled.*, 401.
lucretius, *Cramer*, 365, 366.
lunawara, Butler, 397.
lysianassa, Westw., 366.
Macclounii, *Butler*, 367.
mandarinus, *Felder*, 380, 381.
manica, *Trimen*, 360.
—— ephyra, *Dewitz*, 360.
marmax, *Westw.*, 395, 397, 398.
mars, *Staud.*, 396.
menedemus, *Oberth.*, 381.
midas, *Staud.*, 372.
mixtus, *Rothsch.*, 377.
Monteiri, *Staud.*, 376.
Moorei, *Distant*, 385.
mycerina, *Godart*, 372, 373, 375.
narcæus, *Hewits.*, 380, 381.
nausica, *Staud.*, 373.
neanthes, *Hewits.*, 369, 370.
nepenthes, *H. Grose Smith*, 380.
nessæa, *H. Grose Smith*, 375.
niasicus, *Butler*, 386.
nichetes, *H. Grose Smith*, 372.
Nicholii, *H. Grose Smith*, 389.
nigrescens, *Butler* *, 401.
nitebis, *Hewits.*, 388.
nobilis, *Druce*, 371.
numenes, *Hewits.*, 377.
nyasana, *Butler*, 365.
odysseus, *Staud.*, 349, 366.
ogovensis, *Holland*, 372.
orilus, *Butler*, 357.
paphianus, *Ward*, 402.
papuensis, *Butler*, 395.
parmenion, Felder, 396, 397.
pelias, *Cramer*, 354, 355.
phæus, *Hewits.*, 360, 361.
phœbus, *Butler*, 352.
phraortes, *Doubled.*, 352.
phrixus, *Röber*, 383.
pithodoris, *Hewits.*, 375.
Plateni, *Staud.*, 390.
pleistoanax, *Felder*, 394.
——, var. khasianus, *Butler*, 394.
——, var. khimalara, *Butler*, 394 395.
pollux, *Cramer*, 352, 353.
polyxena, *Cramer*, 392, 393, 394, 396–398.

Charaxes porthos, *H. Grose Smith*, 372.
posidonius, *Leech*, 381.
princeps, *Butler* *, 376.
protoclea, *Feisth.*, 364.
psaphon, *Westw.*, 389, 390, 395.
publius, *Staud.*, 403.
pyrrhus, *Linn.*, 387.
pythodoris, *Hewits.*, 375.
pythodorus, Kirby, 375.
regius, *Auriv.*, 374.
relatus, *Butler*, 371.
repetitus, *Butler* *, 392.
rosæ, *Butler*, 360.
——, var. alladinis, *Dewitz*, 360.
Rothschildi, *Leech*, 380.
samatha, *Moore*, 383, 384.
saturnus, *Butler*, 354.
——, var. laticinctus, *Butler*, 354.
satyrina, *Butler*, var. menedemus, *Oberth.*, 381.
Schreiberi, *Godart*, 386.
scylax, *Felder*, 397.
Selousi, Trimen, 363.
sempronius, *Fabr.*, 387, 388.
——, var. tyrtæus, *Felder*, 388.
serendiba, Moore, 390.
smaragdalis, *Butler*, 375, 376.
Staudingeri, *Rothsch.*, 349, 389.
talagugæ, Holland, 363.
tavetensis, *Rothsch.*, 399.
thibetanus, *Oberth.*, 381.
thomasius, *Staud.*, 368.
Thysii, *Capron.*, 364, 374.
tiridates, *Cramer*, 374, 377, 378.
——, var. mixtus, *Rothsch.*, 377.
tyrtæus, *Felder*, 388.
Ussheri, *Butler*, 403, 404.
varanes, *Cramer*, 348, 365, 370, 400.
viola, *Butler*, 359, 361.
violetta, *H. Grose Smith*, 376.
violinitens, *Crowley*, 402.
viridicostatus, Auriv., 367, 368.
Wallacei, Butler, 396.
Watti, Butler, 390.
Whytei, *Butler*, 363, 374.
xiphares, *Cramer*, 376.
zelica, *Butler*, 372.
zephyrus, Butler, 356.
zoippus, *Mabille*, 351.
zoolina, *Doubled. & Hewits.*, 369, 370.
Cheironitis orsidis, *Reiche*, 287.
Cheloninæ, 124.
Chelonus, *Jurine*, 126.
meridionalis, *Ashm.* *, 126.
Chernetidæ, 272–278.
Childonia Cordierii, 268.
Chilopoda, 297.
Chirocerus furcatus, *Brullé*, 84.
Chiropachides, 155.
Chirosa eurypon, *Hewits.*, 342.
Chlænius canariensis, *Dej.*, 286.
seminitidus, *Chaud.*, 286.
Chrestosema, *Förster*, 68.
pallidipes, *Ashm.* *, 68.
robusta, *Ashm.* *, 68.
Chromoteleia, *Ashm.*, 216, 224.
semicyanea, *Ashm.* *, 224.
Chrysidea, *Spinola*, 150.
aurata, *Ashm.* *, 150.
Chrysididæ, 280, 282.
Chrysis amethystina, *Fabr.*, 282.
cyanura, Förster, 282.
Chrysocharis, *Förster*, 174, 175, 177.
lividiceps, *Ashm.* *, 175, 176.
lividus, *Ashm.* *, 175.
stigmatus, *Ashm.* *, 174, 175.
thoracicus, *Ashm.* *, 175, 176.
Chrysocharodes, *Ashm.* *, 177.
petiolata, *Ashm.* *, 177.
Chrysoglyphe, *Ashm.* *, 160.
albipes, *Ashm.* *, 161, 162.
apicalis, *Ashm.* *, 161.
Cimex militaris, Fabr., 284.
viduatus, Fabr., 283.
Cirrospilus, *Westw.*, 182.
Citharinus, 590, 592, 595–598.
Geoffroyi, 556, 601.
Cladocera, 2–19.
Cladoselache, 584, 587.
Cleonus dealbatus, *Germ.*, 290.
hieroglyphicus, *Oliv.*, 290.
Clinocentrus, *Haliday*, 123.
flaviventris, *Ashm.* *, 123.
Closterocerus, *Westw.*, 176.
albipes, *Ashm.* *, 176, 177.
auriceps, *Ashm.* *, 176, 177.
leucopus, *Ashm.* *, 176, 177.
Clupea, 590, 595.
harengus, 557.
Clupeidæ, 530, 557, 590, 591.
Cnidoglanis, 590.
megastoma, 555.
Coccophagus, *Westw.*, 60, 97.
Lecanii, *Fitch*, 60, 97.
Coccosteus, 585, 587.
Coelopelta, *Ashm.* *, 238.
mirabilis, *Ashm.* *, 238.
Colastes, *Haliday*, 128.
Coleoptera obtained by Dr. Anderson's collector during Mr. T. Bent's Expedition to the Hadramaut, South Arabia, by C. J. Gahan, 285–291.
Collaria morsitans, 298.
Colubridæ, Opisthoglyphous, 322.
Compsomeris vestita, *Klug*, 280, 283.
Comys, *Förster*, 60, 92.
bicolor, *How.*, 60, 92.
Conger, 556, 561, 588, 597, 598.

Conger conger, 545, 601.
Conorhinus, Lap., 284.
Copidosoma, Ratzeb., 92.
diversicornis, How., 92.
Coptops fusca, Oliv., 291.
Coregonus, 555, 596.
pollan, 550, 589.
Cossus ligniperda, 410.
Cottidæ, 530, 569, 571, 593, 599.
Crabro, Fabr., 443.
alacer, Bingh.*, 443.
fossorius, Fabr., 79.
tridentatus, Smith, 444.
(Rhopalum) Brookii, Bingh.*, 444.
Crasodactylus punctatus, Guér., 286.
Cremastobæus, Ashm.*, 217, 228.
bicolor, Ashm.*, 228.
niger, Ashm.*, 228.
Cremastus, Grav., 140.
insularis, Ashm.*, 148.
Cristellaria calcar, 500.
crepidula, 500.
Crossopterygidæ, 587.
Cryptinæ, 138.
Cuchia eel, 53.
Curculionidæ, 290.
Cybister tripunctatus, Oliv., 286.
vulneratus, Klug, 286.
Cyclops, 16, 17.
affinis, G. O. Sars, 18.
magnoctavus, Cragin, 17.
phaleratus, Koch, 18.
prasinus, Jurine (=C. magnoctavus, Cragin), 17.
signatus, Koch, 17.
tenuicornis, Claus, 17.
Cyclopteridæ, 530, 577, 596.
Cyclopterus, 595.
lumpus, 577.
Cylindrogaster, Stål, 523.
nigriceps, Kirby, 523, 524.
rufescens, Kirby*, 524, 529.
Cynipidæ, Report on the Parasitic, of the Island of St. Vincent (W. H. Ashmead), 61–78.
Cynipinæ, 78.
Cynips, Linn., 78.
armatus, Cr., 78.
Cynoidea, dentition of, 461–463.
Cyon, 469.
rutilans, 454, 469; dentition of, 454, 455, 469, 472.
Cypria, 2.
Cyprinidæ, 530, 547, 588, 589.
Cyprinus, 592, 596, 597.
carpio, 548, 589.
Cypris, 2, 3.
monacha, Baird, 5.
Cyrtogaster, Walk., 60, 155.
vulgaris, Walk., 60, 155.
Damon medius, 38.
Danainæ, 340.
Danais, 340–347.
alcippus, Cram., 340, 345, 348.
chionippe, Hübn., 342, 347.
chrysippus, Linn., 340, 341, 345, 346, 347, 348.
dorippus, Klug, 340, 341, 345, 346, 348.
Daphænus, dentition of, 464.
Daphnia, 2, 3.
mucronata, Baird, 5.
Schæfferi, Baird, 2; occurring in London Docks, 2.
Decatoma, Spinola, 59.
orestilia, Walk., 59.
Decatomidea, Ashm.*, 147.
pallidicornis, Ashm.*, 147.
Decticus vittatus, Klug, 282.
Dectisus read Decticus vittatus, Klug, 282.
Dentalina aculeata, D'Orb., 319.
Derostenus, Westw., 173, 175, 177.
acutus, Ashm.*, 173, 174.
quadrimaculatus, Ashm.*, 173.
rotundus, Ashm.*, 173, 174.
Diachasma, Förster, 137.
pilosipes, Ashm.*, 137.
Diadema, 339.
Diapria, Latr., 251.
mellea, Ashm.*, 251.
Diapriinæ, 243, 248.
Diaptomus, 16.
Didelphys, dentition of, 456.
Diglyphosema, Förster, 61.
flavipes, Ashm.*, 61.
Diglyphus, Thomson, 167, 168.
albipes, Ashm.*, 167.
maculipennis, Ashm.*, 167.
Dimeris, Ruthe, 123.
maculipennis, Ashm.*, 123.
Dineutes æreus, Klug, 287.
Dinotus, 155.
Diodon, 594.
hystrix, 582, 583, 602.
Diparides, 156.
Diplatys, Serv., 523.
Diplopoda, 298.
Diplurus, 588.
longicaudatus, Newberry, 588.
Dipneumones, 42.
Diptera: Bent's Expedition to the Hadramaut, South Arabia (W. F. Kirby), 280–285.
Discolia, Sauss., 423.
Dissomphalus, Ashm.*, 192.
bisulcus, Ashm.*, 193, 194.
confusus, Ashm.*, 193, 194.
politus, Ashm.*, 193, 195.
tuberculatus, Ashm.*, 192, 193.

Distira cyanocincta, ftnote 420, 421.
Distomum, On a new Species of, by G. S. West, 322–324.
Distomum Barnaldii, *Sonsino*, 323.
  Boscii, *Cobb.*, 322.
  incerta, *Cobb.*, 322.
  nigrovenosum, *Bellingh.*, ftnote 323.
  Philodryadum, *G. S. West* *, 322, 323, 324.
  signatum, *Duj.*, 323.
  variabile, *Leidy*, 323.
Dog-fishes (Scyllium), egg-cases of, 325.
Dolichurus, *Latr.*, 439.
  bipunctatus, *Bingh.* *, 439.
  taprobana, *Smith*, 439.
Doras, 55.
Doryphora, 411.
  decemlineata, ftnote 411.
Dryininæ, 197.
Dytiscidæ, 286.

Ectrichodia Andersoni, *Kirby* *, 280, 284.
  gigas, *Herr.-Schäff.*, 284.
Egg-cases of some Port Jackson Sharks, by E. R. Waite, 325–329.
Eiphosoma, *Cresson*, 58.
  annulator, *Cr.*, 58.
Elachistinæ, &c. of the Island of St. Vincent (L. O. Howard), 79–108.
Elachistus, *Spin.*, 107.
  albiventris, *Spin.*, 105.
  aureus, *How.* *, 108.
  caudatus, *How.* *, 107.
  scutellatus, *How.* *, 107, 108.
Elasminæ, &c. of the Island of St. Vincent, Report on the (L. O. Howard), 56, 79–108.
Elasmobranchii, 530, 533, 584, 585.
Elasmus, *Westw.*, 101.
  flaviventris, *How.* *, 101, 104.
  flavus, *How.* *, 101, 104, 105.
  helvus, *How.* *, 101, 103, 104.
  levifrons, *How.* *, 101, 102, 103, 105.
  maculatus, *How.* *, 101, 103, 104, 105.
  punctatulus, *How.* *, 101, 102.
  punctatus, *How.* *, 101, 105.
  rugosus, *How.* *, 101, 102, 103, 104.
  Smithii, *How.* *, 101, 104.
Encarsia, *Förster*, 97.
  flaviclava, *How.* *, 97.
Encyrtinæ, &c. of the Island of St. Vincent, Report on the (L. O. Howard), 56, 60, 79–108.
Encyrtus, *Dalm.*, 60, 86, 93.
Encyrtus argentipes, *How.* *, 93, 95.
  brevicornis, *Dalm.*, 95.
  clavellatus, *Dalm.*, 93.
  conifera, Walk., 97.
  crassus, *How.* *, 93.
  cupratus, Förster, 97.
  flaviclavus, *How.* *, 93, 96.
  fuscipennis, *Dalm.*, 94.
  hirtus, *How.* *, 93, 95.
  hyettus, Walk., 88, 89.
  inquisitor, *How.* *, 93.
  nitidus, *How.* *, 93, 94.
  quadricolor, *How.* *, 93.
  tiliaris, *Dalm.*, 60, 86, 93, 97.
  uroceras, *Dalm.*, 86.
Enhydris Hardwickii, ftnote 420.
Entedoninæ, 168.
Entomostraca and the Surface-film of Water, by D. J. Scourfield, 1–19.
Epiphragm, Note on the Formation of the, of *Helix aspersa*, by Prof. G. J. Allman, 517–520.
Epyris, *Westw.*, 188.
  incertus, *Ashm.* *, 189.
  insularis, *Ashm.* *, 188, 189.
Eretes helvolus, *Klug*, 286.
  sticticus, *Linn.*, 286.
  succinctus, *Klug*, 286.
Eribœa lampedo, *Hübn.*, 356.
  unedonis, *Hübn.*, 355.
Erinaceus, dentition of, 455.
Erotolepsia, *How.* *, 99.
  compacta, *How.* *, 100.
Erythrinus, 55.
Erythrolamprus, *Günth.*, 419, 421.
  Æsculapii, *Günth.*, 419, 421, 422
    poison-gland of, 419.
Esocidæ, 530, 545, 588, 589.
Esox, 546, 590, 592, 596.
  lucius, 545, 589, 601.
Eucharinæ, &c. of the Island of St. Vincent, Report on the (L. O. Howard), 56, 59, 79–108.
Eucharis *flabellata*, Fabr., 84.
  furcata, Fabr., 84.
Eucoila, *Westw.*, 57, 75.
  basalis, *Cr.*, 57, 75.
  carinata, *Cr.*, 77.
  claripennis, *Ashm.* *, 75, 76.
  ovalis, *Ashm.* *, 75, 76.
Eucoilidea, *Ashm.* *, 57, 62.
  canadensis, *Ashm.* *, 57, 62.
Eucoilinæ, 57, 61.
Eulepis hamasta, *Moore*, 382.
  Wardii, *Moore*, 404.
Eulophinæ, 60, 165.
Eulophus, *Geoff.*, 166.
  auripunctatus, *Ashm.* *, 166.
Eupelminæ, 56, 87, 91.
Euplectrus, *Westw.*, 60, 105.

Euplectrus bicolor, *Swed.*, 105.
 formicus, *Walk.*, 60, 165.
 maculiventris, *Westw.*, 105.
Euploea, 341, 342, 347.
 climena, *Cram.*, 341.
 core, *Cram.*, 341, 345.
 Hopfferi, 348.
 margoensis, *Butler*, 342.
 polymena, 342, 348.
 pyrgion, 342, 348.
 singapura, *Moore*, 342.
 Whitmei, *Butler*, 342.
Euprepocnemis littoralis, *Ramb.*, 280, 282.
Eurycercus, 2, 3.
Eurypteridæ, 39.
Eurytoma, *Illiger*, 147, 150.
 insularis, *Ashm.* *, 147, 148, 149.
 maculiventris, *Ashm.* *, 148, 149.
 perattinis, *Ashm.* *, 147, 148, 149.
Eurytominæ, 59, 61, 143.
Eurytomocharis, *Ashm.* *, 151.
 minima, *Ashm.* *, 151.
Eusthenopteron Foordi, *Whiteaves*, 588.
Evania, *Fabr.*, 58.
 appendigaster, *Linn.*, 58.
Evaniidæ, 58.
Exochus, *Grav.*, 141.
 tegularis, *Ashm.* *, 141.
 validus, *Cr.*, 141.

Felidæ, dentition of, 461.
Fenestella, 267, 268.
Fenestellidæ, 267.
Figitinæ, 58, 78.
Filistata testacea, *Latr.*, 296.
Fins, the Mesial, of Ganoids and Teleosts, by Prof. T. W. Bridge, 530–602.
Fistulariidæ, 550, 576, 593.
Fistulose Polymorphinæ, on the, and on the Genus *Ramulina*, by T. Rupert Jones and F. Chapman, 496–516.
Flustra cribriformis, 267.
Foraminifera, On a new Genus of, of the Family Astrorhizidæ, by A. Vaughan Jennings, 320–321.
Forficula ruficeps, *Erichs.*, 529.
Forficulidæ, Description of new Species of, in the Collection of the British Museum, by W. F. Kirby, 520–529.
Formica *barbara*, Linn., 283.
 cephalotes, *Linn.*, ftnote 406.
Formicidæ, 280, 283.
Fossorial Hymenoptera, On some Exotic, in the Collection of the British Museum, with Descriptions of New Species and of a new Genus of the Pompilidæ, by Lt.-Col. C. T. Bingham, 422–445.
Frondipora verrucosa, 259, ftnote 262.

Gadidæ, 530, 558, 592.
Gadus, 592, 595.
 æglefinus, 558, 595.
 morrhua, 559.
Gahan, C. J., On the Coleoptera obtained by Dr. Anderson's Collector during Mr. T. Bent's Expedition to the Hadramaut, South Arabia, 285–291.
Galeodes, 32, 35, 37–39, 275, 277.
Galesus, *Curtis*, 248.
 bipunctatus, *Ashm.* *, 248.
Ganaspis, *Förster*, 66.
 apicalis, *Ashm.* *, 66, 67.
 atriceps, *Ashm.* *, 66, 67.
Ganoids and Teleosts, The Mesial Fins of, by Prof. T. W. Bridge, 530–602.
Ganychorus, *Haliday*, 131.
 collaris, *Ashm.* *, 131.
Gasteruption, *Latr.*, 58.
 Guildingii, *Westw.*, 58.
 rufipectus, *Westw.*, 58.
Gilson, Prof. G., On Segmentally disposed Thoracic Glands in the Larvæ of the Trichoptera, 407–412.
——, and Sadones, J., The Larval Gills of the Odonata, 413–418.
Globulina gibba, *Terquem*, 502, 508, 509, 515.
 horrida, *Reuss*, 503, 510, 511.
 oviformis, *Searles Wood, MS.*, 504, 511.
 oviformis, *Terquem*, 505, 508, 513, 515.
 transversa, *Terquem*, 501, 508.
 tuberculata, ftnote 500.
 tubulosa, *d'Orb.*, 509, 510.
 virgata, *Searles Wood, MS.*, 504, 512.
Glyphe, *Walk.*, 162.
 punctata, *Ashm.* *, 162.
Gnamptodon, *Haliday* *, 133.
 atricaudus, *Ashm.* *, 133.
Goniozus, *Förster*, 195.
 incompletus, *Ashm.* *, 195, 196.
 nigrifemur, *Ashm.* *, 195, 196.
 Sancti-Vincenti, *Ashm.* *, 195, 196.
Grammostomum costulatum, ftnote 500.
 laxus, ftnote 500.
 turio, ftnote, 500.
Graptoleberis testudinaria, *Fischer*, 15.
Gryllus bipunctatus, 281.
 littoralis, Ramb., 282.
 subulatus, *Linn.*, 281.
 (Locusta) ægyptius, *Linn.*, 281.
Guttulina damæcornis, *Reuss*, 501, 508.
 gravida, *Terquem*, 502, 509.
 problema, *Terquem*, 508
 racemosa, *Terquem*, 505, 512.
Gymnodontes, 530, 581, 594.

Gymnotidæ, 530, 557, 591, 597, 599.
Gymnotus, 591.
electricus, 557, 601.
Gyrinidæ, 287.
Gyrinus, 14.
Gyrolasia, *Förster*, 179.
bicolor, *Ashm.* *, 179, 180.
ciliata, *Ashm.* *, 180.
femorata, *Ashm.* *, 180.
metallica, *Ashm.* *, 180, 181.

Habrolepis, 95.
Dalmanni, *Westw.*, 91.
Habrolepoidea, *How.* *, 89.
glauca, *How.* *, 90.
Hadronotus, *Förster*, 217, 229.
bicolor, *Ashm.* *, 229, 231.
carinatifrons, *Ashm.* *, 229, 230.
insularis, *Ashm.* *, 229, 230.
politus, *Ashm.* *, 229, 230.
Haliphysema, 321.
Halticella diversicornis, *Walk.*, 81.
fascicornis, *Walk.*, 81.
Halticidæ, 291.
Haridra Adamsoni, *Moore*, 404.
kahruba, *Moore*, 398.
Hecabolinæ, 58, 115.
Heliocopris gigas, *Linn.*, 287.
Helix aspersa, Note on the Formation of the Epiphragm of, by Prof. G. J. Allman, 517–520.
Helix hortensis, 517.
pomatia, 517.
Hemepepsis *read* Hemipepsis, 432.
Hemilexis, *Förster*, 244.
latipennis, *Ashm.* *, 244.
Hemilexodes, *Ashm.*, 244.
filiformis, *Ashm.* *, 244.
Hemipepsis, 432.
prodigiosa, *Gerst.*, 433.
Hemiptera Heteroptera: Bent's Expedition to the Hadramaut, South Arabia, 280, 283.
Hemiscorpius lepturus, *Pet.*, 316.
Hemitrichus, *Thomson*, 157.
varipes, *Ashm.* *, 157.
Henicetrus, *Thomson*, 98.
Heptameris, *Förster*, 71.
flavipes, *Ashm.* *, 71.
rufipes, *Ashm.* *, 71.
Herbertia, *How.* *, 98, 99.
lucens, *How.* *, 98.
Herpetocypris, 2.
Heterobuthus, 309.
Heterogamia conspersa, Brunner, 281.
Heteroptera, 283.
Heterospilus, *Haliday*, 58, 115.
carbonarius, *Ashm.* *, 115, 117.
fasciatus, *Ashm.* *, 115, 118.
ferruginus, *Ashm.* *, 115, 117.
Heterospilus humeralis, *Ashm.* * 117, 121.
longicaudus, *Ashm.* *, 116, 119.
nigrescens, *Ashm.* *, 116, 120.
pallidipes, *Ashm.* *, 116, 119.
quæstor, *Ashm.* *, 58, 116.
variegatus, *Ashm.* *, 117, 120.
Heterotis Ehrenbergii, 53.
Hetrodes horridus, Burm., 282.
Hexacola, *Förster*, 66, 72, 77.
modesta, *Ashm.* *, 72, 73.
Sancti-Vincenti, *Ashm.* *, 72, 73, 74.
solitaria, *Ashm.* *, 72, 73.
Hexaplasta, *Förster*, 77.
incerta, *Ashm.* *, 77.
Himatismus villosus, *Haag*, 290.
Hippocampus guttulatus, 578.
Hirdagra fraterna, *Felder*, 342.
Histerominus, *Gahan* *, 288.
arabicus, *Gahan* *, 288.
Histeromorphus, *Kraatz*, 288.
plicatus, *Kraatz*, 288.
Holocentrum, 564, 592, 594, 595, 598.
spiniferosum, 560, 601.
Holocephala, 530, 534, 584.
Homalopoda, *How.* *, 90.
cristata, *How.* *, 91.
Hoplocrepis, *Ashm.* *, 60, 165.
albiclavus, *Ashm.* *, 60, 165.
Hoploteleia, *Ashm.*, 217.
Howard, L. O., Report on the Chalcididæ of the subfamilies Chalcidinæ, Eucharinæ, Perilampinæ, Encyrtinæ, Aphelininæ, Pireninæ, Elasminæ, and Elachistinæ, of the Island of St. Vincent, 79–108.
——, Report upon the Parasitic Hymenoptera of the Island of Vincent, *see* Riley, C. V., 56–254.
Hydaticus decorus, *Klug*, 286.
histrio, *Clark*, 286.
rectangulus, *Sharp*, 286.
Hydrophiinæ, ftnote 420.
Hydrophilidæ, 287.
Hydrous senegalensis, *Perch.*, 287.
Hydrus platurus, ftnote 420.
Hymenoptera: Bent's Expedition to the Hadramaut, South Arabia, by W. F. Kirby, 280–282.
Hymenoptera, Parasitic, of the Island of St. Vincent: Report upon, by C. V. Riley, W. H. Ashmead, and L. O. Howard, 56–254.
Hymenoptera, On some Exotic Fossorial, in the Collection of the British Museum, with Descriptions of New Species and of a New Genus of the Pompilidæ, by Lt.-Col. C. T. Bingham, 422–445.
Hypolethria, *Förster*, 71.

Hypolethria longicornis, *Ashm.* *, 71.
Hypolimnas, Mimicry in the Butterflies of the Genus, by Col. Chas. Swinhoe, 339-348.
Hypolimnas anomale, 341.
bolina, *Linn.*, 339-348.
dubia, 343, 348.
marginalis, 343, 348.
mina *read* mima, *Trim.*, 343.
misippus, *Linn.*, 339-348.
polymena, 342, 348.
scopas, 342, 348.
Hypostomos, 55.

Ichneumonidæ, Report on the, of the Island of St. Vincent (W. H. Ashmead), 56, 138-143.
Ichthyoxenos, *Herklots*, 337.
Idarnes, *Walk.*, 59.
carme, *Walk.*, 59.
Idiotypa, *Förster*, 243.
pallida, *Ashm.* *, 243.
Idmonea, 267.
flabellata, *Kirchenp.*, 267.
interjuncta, 267.
Milneana, 267.
Idris, *Förster*, 217, 231.
ænea, *Ashm.* *, 231.
Inostemma, *Hal.*, 232, 233.
bicornutus, *Ashm.* *, 232.
Lintnerii, *Ashm.*, 233.
simillimus, *Ashm.* *, 232.
Insects other than Coleoptera obtained by Dr. Anderson's Collector during Mr. T. Bent's Expedition to the Hadramaut, South Arabia, 279-285.
Isamia (Euplœa) singapura, *Moore*, 342.
Isobrachium, *Förster*, 190, 192.
albipes, *Ashm.* *, 190, 191.
collinum, *Ashm.* *, 190.
Isocratus, *Förster*, 59, 170.
vulgaris, *Walk.*, 59.
Isopod, On the Structure of the, Genus *Ourozeuktes*, Milne-Edwards, by A. Vaughan Jennings, 329-338.
Isopods, gills of, 417.
Isosoma, *Walk.*, 149, 151.
heteromera, *Ashm.* *, 151.
Isosomodes, *Ashm.*, 59
gigantea, *Ashm.*, 59.

Jasia australis, *Swains.*, 388.
Jennings, A. Vaughan, On the True Nature of "Möbiusispongia parasitica," *Duncan*, 317-319.
——, On a new Genus of Foraminifera of the Family Astrorhizidæ, 320-321.
——, On the Structure of the Isopod Genus *Ourozeuktes*, Milne-Edwards, 329-338.
Jones, T. Rupert, and Chapman, F., On the Fistulose Polymorphinæ, and on the Genus *Ramulina*, 496-516.

Kapala, *Cameron*, 59, 84.
furcata, *Fabr.*, 59, 84.
Kirby, W. F., Descriptions of new Species of Forficulidæ in the Collection of the British Museum, 520-529.
——, Insects other than Coleoptera obtained by Dr. Anderson's Collector during Mr. T. Bent's Expedition to the Hadramaut, South Arabia, 279-285.
Kleidotoma, *Westw.*, 69.
insularis, *Ashm.* *, 69.

Labeo, *Hal.*, 197.
Sancti-Vincenti, *Ashm.* *, 197.
simulans, *Ashm.* *, 197, 198.
Labidura, *Leach*, 524, 525.
sexspinosa, *Dohrn*, 524.
Walkeri, *Kirby* *, 524, 529.
Labrichthys tetrica, 576.
Labridæ, 530, 574, 593, 596, 598.
Labyrinthici, epibranchial organ in, mentioned, 53.
Laccotrephes ruber, *Linn.*, 280, 284.
Lampronota, *Curtis*, 142.
albomaculata, *Ashm.* *, 142.
Lapitha, *Ashm.*, 217, 226.
spinosa, *Ashm.* *, 226.
Larval Gills of the Odonata, Prof. G. Gilson and J. Sadones on, 413-418.
Lathrodectus 13-guttatus, *Rossi*, 296.
Laurie, M., On the Morphology of the Pedipalpi, 20-48.
Lecanium hesperidum, *Linn.*, 92, 97.
quercitronis, *Fitch*, 97.
Leiurus leptochelys, *Hempr. & Ehrenb.*, 299.
quinquestriatus, *Hempr. & Ehrenb.*, 299.
Lelaps, *Hal.*, 60, 156.
flavescens, *Ashm.* *, 156.
pulchricornis, *Hal.*, 60, 156.
Lepidosiren, 52, 54.
paradoxa, ftnote 52.
Lepidosteidæ, 530, 540.
Lepidosteus, 538, 541, 544, 545, 586-596.
osseus, 540, 601.
Lepralia, 257.
Leptacis, *Förster*, 236.
erythropus, *Ashm.* *, 236, 237.
obscuripes, *Ashm.* *, 236.
Leptomastix, *Förster*, 60, 92.
dactylopii, *How.*, 60, 92.
Leptopilina, *Förster*, 70.
minuta, *Ashm.* *, 70.
Libellula, 413, 417.
depressa, 413, 414.

Limnophilus flavicornis, 408, 409.
Limulus, 33, 37-46, 275, 277, 417.
Liophis, 419.
Liophron, *Nees*, 132.
minutus, *Ashm.* *, 132.
Liophroninæ, 132.
Liphistius, 42, 46.
Lituolidæ, 321.
Lochites, *Förster*, 153.
auriceps, *Ashm.* *, 153.
Locusta ægyptius, *Linn.*, 281.
Locustidæ, 280, 281, 282.
Lophobranchii, 530, 578, 594, 597.
Lophocomus, *Hal.*, 165.
Loxostomum vorax, ftnote 500.
Loxotropa, *Förster*, 249.
columbiana, *Ashm.* *, 249.
thoracica, *Ashm.* *, 249.
Lutodeira chanos, *Hyrtl*, 53.
Lygæidæ, 280, 284.
Lygæus militaris, *Fabr.*, 280, 284.
Lysiphlebus, *Förster*, 137.
meridionalis, *Ashm.* *, 137.
Lysitermus, *Förster*, 121.
fascipennis, *Ashm.* *, 121, 122.
terminalis, *Ashm.* *, 121.

Macromeris, *Lepel.*, 429, 438.
argentifrons, *Smith*, 429.
castanea, *Bingh.* *, 438.
Macroteleia, *Westw.*, 216, 217, 222.
carinata, *Ashm.* *, 222.
erythrogaster, *Ashm.* *, 222, 223.
Sancti-Vincenti, *Ashm.* *, 222, 223.
Marsipella, 321.
Marsipobranchs, 584, 587.
Marsupials, dentition of, 456.
Melittobia, *Westw.*, 182.
Meraporus, *Walk.*, 159.
nigrocyaneus, *Ashm.* *, 159.
Merluccius, 592.
vulgaris, 559.
Mesial Fins of Ganoids and Teleosts, by Prof. T. W. Bridge, 530-602.
Mesochorus, *Grav.*, 140.
americanus, *Cr.*, 141.
annulitarsis, *Ashm.* *, 140.
Mesoprion, 592-595, 598.
gembra, 565, 601, 602.
Mesostena puncticollis, *Sol.*, 289.
Mesostenus, *Grav.*, 138.
insularis, *Ashm.* *, 138.
Micoconodon *read* Microconodon, 477.
Microbracon, *Ashm.*, 114.
pilosithorax, *Ashm.* *, 114.
Microconodon, 474, 477.
Microdus, *Nees*, 58, 129.
insularis, *Ashm.* *, 130.
Smithii, *Ashm.* *, 129.
stigmaterus, *Cr.*, 58.
Microdus unicinctus, *Ashm.* *, 129.
varipes, *Cr.*, 58.
Microgasterinæ, 56.
Middleton, R. Morton, Jn., on a remarkable use of Ants in Asia Minor, 405.
Mimicry in Butterflies of the Genus *Hypolimnas*, by Col. Chas. Swinhoe, 339-348.
Miotropis, *Thomson*, 106.
nigricans, *How.* *, 106.
platynotæ, How., 106.
versicolor, *How.* *, 106.
Misilus aquatifer, *Montfort*, 514.
Möbiusispongia parasitica, *Duncan*, on the True Nature of, by A. Vaughan Jennings, 317-319.
Monacanthus, 336, 594.
granulosus, 580.
pardalis, 580.
Morpho, 380.
Mugil, 573, 575, 598.
capito, 572, 595, 602.
Mugilidæ, 530, 569, 572, 593, 595, 598, 599.
Muræna, 596.
Murænidæ, 530, 545, 588.
Mustelidæ, dentition of, 461.
Mygnimia, 434.
audax, Smith, 434.
fenestrata, Smith, 434.
Myosoma, *Brullé*, 113.
pilosipes, *Ashm.* *, 113.
Myriopoda and Arachnida: Bent's Expedition to the Hadramaut, South Arabia, by R. I. Pocock, 297-299.
Myrmicinæ, 283.
Myzine, *Latr.*, 423.
dimidiata, *Smith*, 423.
dimidiaticornis, *Bingh.* *, 423.

Nanobuthus, *Pocock* *, 314.
Andersoni, *Pocock* *, 314.
Nebo flavipes, *Simon*, 295, 316.
Nepa *grossa*, Fabr. 284, 285.
rubra, Linn., 284, 285.
Nepidæ, 280, 284.
Neuroptera: Bent's Expedition to the Hadramaut, South Arabia (W. F. Kirby), 280-282.
Newnhamia, *King*, 5.
Notaspis, *Walk.*, 59, 83.
formiciformis, *Walk.*, 59, 83.
Notodromas, 5, 11, 12, 15, 16, 17.
monacha, *O. F. M.*, 5, 10, 12, 13, 19.
Nototrachys, *Marshall*, 139.
minimus, *Ashm.* *, 139.
niger, *Ashm.* *, 139.
Nubecularia, 321.
Nymphalis candiope, *Godart*, 367.
decius, Lucas, 404.

Nymphalis erithalion, *Westw. & Hewits.*, 362.
etesipe, *Godart*, 399.
etheocles, *Drury*, 399.
Freyi, Branesik, 369.
Guderiana, *Dewitz*, 358.
jahlusa, *Trimen*, 371.
mycerina, *Godart*, 372.
nesiope, *Hewits.*, 373.
nitebis, *Hewits.*, 388.
numenes, *Hewits.*, 376.
pyrrhus, Lucas, 387.
Schreiberi, *Godart*, 386.
thieste, *Westw.*, 376.
thurius, *Godart*, 376,
zoolina, *Doubl. & Hewits.*, 370.

Ocnera hispida, *Forsk.*, 290.
persea, *Baudi*, 290.
Odonata, The Larval Gills of the, by Prof. G. Gilson and J. Sadones, 413–418.
Œcodoma cephalotes, *Latr.*, ftnote 406.
Œdipoda nebulosa, *Fisch. de Waldh.*, 281.
Œstridæ, 280, 285.
Œstrus maculatus, Wiedem., 285.
Olinx, *Förster*, 166.
Omphale, *Hal.*, 168.
varicolor, *Ashm.* *, 168.
Onitis alexis, *Klug*, 287.
Ophiocephalidæ, 53.
Ophion, *Fabr.*, 58.
concolor, *Cr*, 58.
cubensis, *Nort.*, 58.
flavum, *Fabr.*, 58.
Ophioninæ, 58, 139.
Opiinæ, 133.
Opisthacantha, *Ashm.*, 216, 224.
pallida, *Ashm.* *, 225.
polita, *Ashm.* *, 224, 225.
Opisthoglyphous Snakes, On two little-known, by G. S. West, 419–422.
Opius, *Wesm.*, 133.
annulicornis, *Ashm.* *, 134, 136.
atriceps, *Ashm.* *, 134, 136.
insularis, *Ashm.* *, 133, 135.
interstitialis, *Ashm.* *, 134, 135.
melanocephalus, *Ashm.* *, 133, 134.
rejectus, *Ashm.* *, 134, 136.
Salvini, *Ashm.* *, 133, 134.
unifasciatus, *Ashm.* *, 134, 135.
Orasema, *Cameron*, 59, 84.
minutissima, *How.* *, 84.
stramineipes, *Cameron*, 59, 85.
Orgilus, *Haliday*, 130.
pallidus, *Ashm.* *, 130.
Orthagoriscus, 594.
mola, 582.
Orthocentrus, *Grav.*, 141.
insularis, *Ashm.* *, 142.
Orthocentrus variabilis, *Ashm.* *, 141.
Orthochirus melanurus, *Kessler*, 294.
Schneideri, *L. Koch*, 295.
Orthoptera: Bent's Expedition to the Hadramaut, South Arabia (W. F. Kirby), 279–281.
Oryctes boas, *Fabr.*, 287.
rhinoceros, *Linn.*, 287.
Osteoglossidæ, 53, 530, 544, 588.
Osteoglossum, 545, 546, 592, 596.
formosum, 544, 601.
Ostracoda, 2–19.
Otocyon, dentition of, 461–474.
megalotis, 464; dentition of, 464–467.
Ourozeuktes, *Milne-Edwards*, On the Structure of the Isopod Genus, by A. Vaughan Jennings, 329–338.
Ourozeuktes caudatus, *Schiödte & Meinert*, 336.
monacanthi, *Schiödte & Meinert*, 336.
Owenii, *Milne-Edw.*, 330, 338.
pyriformis, *Hasw.*, 336.
Oxycara sp., 289.

Pachnoda histrio, *Fabr.*, 287.
Pagellus, 566, 569, 595, 598.
centrodontus, 566.
Palla, 348, 370.
publius, *Staud.*, 403.
Pallosoma cyanea, *Lep.*, 427.
Palmicellaria, 267.
parallelata, 255, 267, 268, 271.
Pambolinæ, 122.
Pambolus, *Haliday*, 122.
annulicornis, *Ashm.* *, 122.
Paphagus, *Walk.*, 59.
sidero, *Walk.*, 59.
Paphia Schreibers, Horsf., 386.
Papilio amasia, *Fabr.*, 378.
anticlea, *Drury*, 364.
athamas, *Drury*, 383.
Bernardus, *Fabr.*, 392.
brutus, *Cramer*, 350.
cajus, *Herbst*, 350.
camulus, Drury, 352.
castor, *Cramer*, 353.
cenea, *Stoll*, 345.
decius, *Cramer*, 403.
ephyra, *Godart*, 359.
etheocles, *Cramer*, 359.
etheocles, Drury, 399.
eudoxus, *Fabr.*, 352.
eupale, *Drury*, 378.
euphanes, *Esper*, 356.
euryalus, *Cramer*, 399.
Fabius, *Fabr.*, 356.
Horatius, *Fabr.*, 364.
jasius, *Fabr.*, 355.
jason, *Linn.*, 355.

Papilio laodice, *Drury*, 373.
lucretius, *Cramer*, 366.
lycurgus, Fabr., 373.
marica, *Fabr.*, 377.
merope, 343, 344.
nisus, Cramer, 399.
pelias, *Cramer*, 355.
pollux, *Cramer*, 352, 353.
polyxena, *Cramer*, 392.
pyrrhus, *Linn.*, 387.
pyrrhus, Donov., 384.
rhea, *Hübner*, 355.
sempronius, *Fabr.*, 388.
solon, Fabr., 356.
tiridates, *Cramer*, 377.
thyestes, *Stoll*, 376.
varanes, *Cramer*, 400, 401.
xiphares, *Cramer*, 376.
Parabuthus, *Pocock*, 309, 311.
brevimanus, *Thorell*, 309.
capensis, *Hempr. & Ehrenb.*, 309.
fulvipes, *Simon*, 309.
granimanus, *Pocock* *, 311, 312, 315.
Hunteri, *Pocock* *, 309, 310, 311, 312.
iros, *C. Koch*, 309.
liosoma, *Hempr. & Ehrenb.*, 295, 309, 310, 311, 312, 315, 316.
pallidus, *Pocock* *, 312.
planicauda, *Pocock*, 309.
segnis, *Thorell*, 309.
villosus, *Peters*, 309, 316.
Paragenia, *Bingh.* *, 429.
argentifrons, *Smith*, 429, 445.
Parallelata vitrea, 267.
Paramesius, *Westw.*, 245.
thoracicus, *Ashm.* *, 245.
Paraolinx, *Ashm.* *, 166.
lineatifrons, *Ashm.* *, 166.
Pedipalpi, On the Morphology of, by M. Laurie, 20–48.
Pedipalpi, 296.
Pentacrita, *Förster*, 70.
obscuripes, *Ashm.* *, 70.
Pentastichus, *Ashm.* *, 187.
xanthopus, *Ashm.* *, 188.
Pentatoma nigroviolacea, *Beauv.*, 283.
Pentatomidæ, 280, 283.
Peraspalax, 477.
Perca, 564, 567, 569, 593, 595.
fluviatilis, 564.
Percidæ, 530, 564, 592, 593, 598, 599.
Perilampinæ &c. of the Island of St. Vincent, Report on the (L. O. Howard), 56, 79–108.
Perilampus, *Latr.*, 85.
politifrons, *How.* *, 85.
Peripatus, 410; salivary glands of, 411, 412.
Petralia, 255, 260.
Petralia undata, 267.
Peucetia arabica, *Simon*, 296.
Phænocarpa, *Förster*, 137.
pleuralis, *Ashm.* *, 137.
Phænopria, *Ashm.*, 253.
simillima, *Ashm.* *, 253.
subclavata, *Ashm.* *, 253, 254.
Phænotoma, *Wesm.*, 124.
fuscovaria, *Ashm.* *, 124, 126.
humeralis, *Ashm.* *, 124, 125, 126.
insularis, *Ashm.* *, 124.
meridionalis, *Ashm.* *, 124, 125.
Phalangidæ, 21, 38, 39.
Phalangium, 34, 44.
Phanurus, *Thomson*, 200.
affinis, *Ashm.* *, 200.
ovivorus, *Ashm.*, 201.
Phasma, *Oliv.*, 281.
ægyptiacum, *Gray*, 279, 281.
rossia, *Fabr.*, 281.
Phasmidæ, 279, 281.
Pheropsophus africanus, *Dej.*, var., 286.
Philanthus, *Fabr.*, 440.
avidus, *Bingh.* *, 440.
basalis, *Smith*, 441.
concinnus, *Bingh.* *, 441.
nigriceps, *Bingh.* *, 441.
ordinarius, *Bingh.* *, 441.
pulcherrimus, *Smith*, 440.
Philodryas Schottii, 322.
Philognoma azota, *Hewits.*, 365.
falcata, *Butler*, 402.
lichas, *Doubled.*, 401.
rectifascia, Weymer, 403.
Ussheri, *Butler*, 404.
violinitens, *Crowley*, 402.
Phryganea grandis, 407, 408, 409.
Phrynichus ceylonicus, 38.
Deflersi, *Simon*, 296.
Jayakari, *Poc.*, 296.
Phipsoni, 296.
pusillus, 296.
Phrynus: On the Spinning-Glands in, with an Account of the so-called "Penis," and of the Morphology of the Operculum, by H. M. Bernard, 272–278.
Phrynus, 20, 21, 25, 38, 40–48; embryos of, 30.
annulatipes, 48.
reniformis, 31, 48.
Phyllopods, 2.
Physostomi, 530, 544, 597.
Picroscytus, *Thomson*, 157.
nigro-cyaneus, *Ashm.* *, 158.
Pilulina, 321.
Pimelia arabica, *Klug*, 290.
sp., 290.
Pimplinæ, 142.
Pirates, *Burm.*, 284.

Pireninæ, &c., of the Island of St. Vincent, Report on the (L. O. Howard), 56, 79–108.
Placopsilina, 321.
  bulla, 321.
Platurus fasciatus, ftnote 420.
Platygaster *Lecanii*, Fitch, 97.
Platygasterinæ, 232.
Platynota rostrana, *Walk.*, 107.
Platystoma, 553, 554, 555, 590.
  tigrinum, 550, 601.
Plectognathi, 530, 578, 594, 597.
Pleuracanthus, 584, 587.
Pleuronectes, 592.
  platessa, 559, 601.
Pleuronectidæ, 530, 559, 592, 597.
Plocæderus denticornis, *Fabr.*, 291.
  melancholicus, *Gahan*, var., 291.
Pocock, R. I., On the Arachnida and Myriopoda obtained by Dr. Anderson's collector during Mr. T. Bent's Expedition to the Hadramaut, South Arabia; with a Supplement upon the Scorpions obtained by Dr. Anderson in Egypt and the Eastern Soudan, 292–316.
——, List of the Scorpions obtained by Colonel Yerbury at Aden in the Spring of 1895, 316.
——, Supplementary Note upon the Scorpions obtained in Egypt and the Soudan by Dr. John Anderson, 299.
Podagrion, *Spin.*, 83.
  brasiliensis, *How.* *, 83.
Pœcilocera, 282.
  vittata, *Klug*, 280, 282.
Polyclada Benti, *Gahan* *, 291.
  pectinicornis, *Oliv.*, 291.
Polygnotus, *Förster*, 240.
  gracilicornis, *Ashm.* *, 241, 242.
  insularis, *Ashm.* *, 240, 241, 242.
  laticlavus, *Ashm.* *, 241, 242.
  meridionalis, *Ashm.* *, 240, 241.
  pallidicoxalis, *Ashm.* *, 241, 243.
Polymoecus, *Förster*, 237.
  insularis, *Ashm.* *, 237.
Polymorpha corcula spinosa, *Soldani*, 508, 511, 513, 514.
  oliviformia, *Soldani*, 512.
  oviformia, *Soldani*, 512.
  pyriformis, *Soldani*, 512.
  subovalia, *Soldani*, 509, 510, 513.
Polymorphina amygdaloides, *Terquem*, 511.
  angusta, *Egger*, 508, 515, 516.
  ——, var. complicata, *Jones & Chapm.* *, 507, 508, 516.
  asparagus, ftnote 500.
  communis, *d'Orb.*, 502, 508–510, 513, 516.
Polymorphina communis, var. acuplacenta, *Jones & Chapm.* *, 502, 516.
  ——, var. horrida, *Reuss*, 502, 503, 516.
  communis, Parker & Jones, 507, 512, 513.
  compressa, *d'Orb.*, 507, 514, 516.
  ——, var. marginalis, *Jones & Chapm.* *, 507, 516.
  compressa, Brady, 514.
  compressa, Goës, 509.
  concava, *Williamson*, 498, 507, 514.
  ——, var. dentimarginata, *Chapm.*, 507, 514.
  concava, R. Jones, 514.
  damæcornis, *Wright*, 501, 509, 511.
  damæcornis, Reuss, 501.
  diffusa, 499.
  diluta, *Bornem.*, 502.
  fusiformis, *Roemer*, 503, 510–512, 516.
  ——, var. horrida, *Reuss*, 503, 516.
  ——, var. racemosa, *Jones & Chapm.* *, 503, 504, 516.
  gibba, *d'Orb.*, 501, 502, 508–516.
  ——, var. acuplacenta, *Jones & Chapm.* *, 502, 516.
  ——, var. circularis, *Jones & Chapm.* *, 505, 516.
  ——, var. complicata, *Jones & Chapm.* *, 507, 508, 516.
  ——, var. coronula, *Jones & Chapm.* *, 501, 516.
  ——, var. damæcornis, *Reuss*, 501, 516.
  ——, var. diffusa, *Jones & Chapm.* *, 505, 516.
  ——, var. marginalis, *Jones & Chapm.* *, 506, 516.
  ——, var. racemosa, *Jones & Chapm.* *, 503, 504, 516.
  gibba, Brady, 513.
  gibba, Goës, 514.
  gibba, Wright, 514.
  gracilis, *Reuss*, 510.
  gutta, *d'Orb.*, 502, 505, 509, 510, 513, 516.
  ——, var. acuplacenta, *Jones & Chapm.* *, 502, 516.
  ——, var. diffusa, *Jones & Chapm.* *, 505, 516.
  hirsuta, *d'Orb.*, 503, 516.
  ——, var. complicata, *Jones & Chapm.* *, 507, 508, 516.
  ——, var. horrida, *Reuss*, 502, 503, 516.
  hirsuta, *Reuss*, 511, 512, 515.
  horrida, *Wright*, 503, 510, 515.
  horrida, Burrows, Sherborn, & Bailey, 510.
  Humboldtii, *Bornem.*, 507, 513, 516.

Polymorphina Humboldtii, var. marginalis, *Jones & Chapm.* *, 506, 516.
lactea, *Walk. & Jacob*, 502, 511–516.
——, var. diffusa, *Jones & Chapm.* *, 505, 516.
——, var. fistulosa, *Williams*, 515.
——, var. marginalis, *Jones & Chapm.* *, 507, 516.
——, var. racemosa, *Jones & Chapm.* *, 503, 504, 516.
——, var. tubulosa, *Parker & Jones*, 507, 512, 513.
lactea, Brady, 502, 510.
lanceolata, *Reuss*, 503, 510.
nucleus, ftnote 500.
Orbignii, *Brady, Parker, & Jones*, 507, 508, 511, 515–516.
prælonga, *Terquem*, 504, 511.
prisca, *Berthelin*, 503, 510.
prisca, Reuss, 511.
problema, *d'Orb.*, 505, 508, 512, 516.
——, var. circularis, *Jones & Chapm.* *, 505, 516.
regina, *Brady, Parker, & Jones*, 501, 509, 512, 514, 516.
——, fistulose form, *Wright*, 509.
——, var. damæcornis, *Reuss*, 501, 516.
——, var. marginalis, *Jones & Chapm.* *, 507, 516.
Roemeri, *Reuss*, 502, 509, 510.
rotundata, *Bornem.*, 505, 513, 515, 516.
——, var. complicata, *Bornem.*, 507, 508, 516.
——, var. diffusa, *Jones & Chapm.* *, 505, 516.
solidula, *Terquem*, 505, 513.
sororia, *Reuss*, 510, 515, 516.
trigonula, *Reuss*, 501, 508, 516.
——, var. damæcornis, *Reuss*, 501, 516.
tubulosa, *Jones, Parker, & Brady*, 499, 504, 505, 509, 511, 513, 515, 516.
turio, ftnote 500.
virgata, *Searles Wood*, 504, 512, 516.
——, var. racemosa, *Jones & Chapm.* *, 503, 504, 516.
(Guttulina) damæcornis, *Reuss*, 501, 508.
Polymorphinæ, On the Fistulose, and on the Genus *Ramulina*, by T. Rupert Jones and F. Chapman, 496–516.
Polyodon, 536, 538, 585.
folium, 536, 601.
Polyodontidæ, 530, 536.
Polyphaga syriaca, *Sauss.*, 279, 281.
Polypteridæ, 530, 541.
Polypterus, 543, 586, 587, 590, 602.
bichir, 541, 601.
Pompilidæ, 422.
Pompilus, *Fabr.*, 429.
Aliciæ, *Bingh.* *, 431, 445.
aureosericeus, *Guér.*, 433, 434.
bioculatus, *Bingh.* *, 431.
canifrons, *Smith*, 430.
Dædalus, *Bingh.* *, 429.
exortivus, *Smith*, 430, 431.
infestus, *Bingh.* *, 430.
perplexus, *Smith*, 430.
unifasciatus, *Smith*, 430, 431, 434.
Porcellanea, 321.
Potorous, dentition of, 459.
Priocnemis, 434.
gigas, *Taschenb.*, 433, 434.
Prionodon, 463.
Prionotheca carinata, *Oliv.*, 290.
Prionurus, 303, 305, 309.
æneas, *C. Koch*, 309.
australis, *Linn.*, 305, 306.
bicolor, *Hempr. & Ehrenb.*, 294, 307, 308, 309.
citrinus, *Hempr. & Ehrenb.*, 304, 305, 306, 307, 308.
crassicauda, *Oliv.*, 292, 303, 307, 308, 309.
funestus, *Hempr. & Ehrenb.*, 303, 304, 305, 309.
hector, *Koch*, 304, 305, 306, 307.
libycus, *Hempr. & Ehrenb.*, 304, 305, 306, 307, 308.
melanophysa, *Ehrenb.*, 304, 305, 306.
priamus, *Koch*, 305, 306, 307, 308.
Proctotrypidæ, Report on the, of the Island of St. Vincent (W. H. Ashmead), 56, 188–254.
Prodaticus pictus, *Sharp*, 286.
Proroporus verrucosus, ftnote 500.
Prosacantha, *Nees*, 213.
brevispina, *Ashm.* *, 213.
sublineata, *Ashm.* *, 213, 214.
tibialis, *Ashm.* *, 213, 214.
Proteleidæ, dentition of, 461.
Protopterus, 52, 53.
annectens, ftnote 52.
Psalis, *Serv.*, 525.
borneensis, *Kirby* *, 525.
indica, *Burm.*, 525.
Psen, *Latr.*, 443.
pulcherrimus, *Bingh.* *, 443.
Pseudagenia, *Kohl*, 426, 429.
artemis, *Bingh.* *, 427, 445.
clypeata, *Bingh.* *, 427.
Erigonæ, *Bingh.* *, 426, 445.
mutabilis, *Smith*, 428.
novaræ, *Sauss.*, 426.
rava, *Bingh.* *, 426.
stulta, *Bingh.* *, 428.
tincta, *Smith*, 428.
Pseudoscarus, 575.
superbus, 574, 602.

Pseudoscorpions, 37, 39.
Pteromalinæ, 60, 155, 157.
Pteromalus, *Swed.*, 165.
rugosopunctatus, *Ashm.* *, 165.
Pterygotus, 37.
Pulvinaria innumerabilis, *Rathvon*, 97.
Puntius maculatus, *Bleeker*, 337.
Pygidicrana, *Serv.*, 522.
egregia, *Kirby* *, 523, 529.
forcipata, *Kirby* *, 522
v-nigra, *Serv.*, 522, 523.

Ramulina, On the Genus, and on the Fistulose Polymorphinæ, by T. Rupert Jones and F. Chapman, 496–516.
Ramulina, *Wright*, 318, 319.
globulifera, *Brady*, 319.
Grimaldii, *Schlumb.*, 319.
Raphanulina Humboldtii, *Zborzewski*, 513.
Reduviidæ, 280, 284.
Regalecus, 591, 594.
argenteus, 530, 577.
Retehornera, 267.
Reteporæ, and a Fenestrate Bryozoa, On Mediterranean and New-Zealand, by A. W. Waters, 255–271.
Retepora, 255, 257, 260.
aporosa, *Waters*, 260, 261.
arborea, Jullien, 264, 265.
atlantica, *Busk*, 259, 261, 264.
aurantiaca, 269.
avicularis, *MacG.*, 256, 262.
Beaniana, *King*, 259, 260, 261, 264, 271.
cellulosa, *Linn.*, 256, 259, 260, 261, 263, 266–271.
——, *forma Beaniana*, var. *mediterranea*, Smitt, 263.
cellulosa, Smitt, 259.
cellulosa, Van Beneden, 264.
cellulosa, Waters, 263.
Colensoi, *Busk MS.*, 270.
columnifera, *Busk*, 256, 261.
complanata, *Waters*, 260, 261, 263, 271.
contortuplicata, *Busk*, 256, 261.
Couchii, *Hincks*, 256, 261–263.
——, var. aporosa, *Waters*, 262, 271.
——, var. biaviculata, *Waters*, 262, 271.
denticulata, 256.
deserta, *Waters*, 268.
elegans, *Reuss*, ftnote 255.
elongata, *Smitt*, 256, 257, 262, 265, 278.
——, *Smitt* (=R. tenella, *Ortm.*), 261.
escharoides, 257.
fissa, *MacG.*, 256, 259, 260, 261,
Retepora formosa, *MacG.*, 258, 261.
gigantea, *Busk*, 256, 269.
granulata, 257, 269.
Imperati, *Busk*, 256, 257, 258, 262, 265, 266, 270, 271.
Jacksoniensis, *Busk*, 256, 261.
lata, *Busk*, 262.
lucida, 260.
magellensis, *Busk*, 262.
maorica, *Busk MS.*, 269.
marsupiata, *Sm.*, 260.
mediterranea, *Smitt*, 256, 259, 260, 261, 263, 271.
monilifera, 256, 258, 261, 269.
——, forma munita, *Hincks*, 269.
——, var. minuta, *MacG.*, 260, 271.
munita, *MacG.*, 261, 269.
novæ zealandiæ, *Waters*, 262, 270, 271.
parallelata, *Waters*, 266.
plana, *Hincks*, ftnote 257.
porcellana, *MacG.*, 261, 269.
prætenuis (=R. marsupiata, *Sm.*), 260.
producta, *Busk*, 257, 261.
reticulata, *Lamk.*, 259, 262.
sinuosa, *Kirkp.*, 257, 262.
Solanderia, *Risso*, 256, 257, 258, 262, 264, 265, 266, 271.
tenella, *Ortm.*, 265.
tessellata, *Hincks*, 257, 258, 259, 262, 271.
——, var. cæspitosa, *Busk*, ftnote 256, 265, 271.
tubulata, *Busk*, 256, 261.
tumescens, *Ortm.*, 265.
umbonata, *MacG.*, 260, 261.
victoriensis, *Busk*, 261.
Reteporella, *Busk*, 258, 265.
Solanderia, 258.
Worsleyi, *MacG.*, 258.
Reticulipora dorsalis, *Waters*, 265.
Rhaphidoscene, *Jennings* *, 321.
conica, *Jennings* *, 321.
Rhogadinæ, 123.
Rhogas, *Nees*, 123.
pectoralis, *Ashm.* *, 123.
Rhopalum Brookii, *Bingh.* *, 444.
Rhoptromeris, *Förster*, 74.
insularis, *Förster*, 74.
Rhyssalinæ, 127.
Rhyssalus, *Haliday*, 127, 128.
brunneiventris, *Ashm.* *, 128.
cænophanoides, *Ashm.* *, 127.
melleus, *Ashm.* *, 127.
Riley, C. V., W. H. Ashmead, and L. O. Howard, Report upon the Parasitic Hymenoptera of the Island of St. Vincent, 56–254.
Rileya, *Ashm.*, 61, 143.

Roptrocerus, *Ratzeb.*, 158.
auratus, *Ashm.* *, 158.

Saccobranchus fossilis, On the Aortic-Arch System of, by R. H. Burne, 48–55.
Saccobranchus singio, 54.
Sactogaster, *Förster*, 237.
affinis, *Ashm.* *, 238.
anomaliventris, *Ashm.*, 238.
rufipes, *Ashm.* *, 238.
Sadones, J., and Prof. G. Gilson, The Larval Gills of the Odonata, 413–418.
Sagrina longirostris, ftnote 500.
Salius, *Fabr.*, 432.
anthracinus, *Smith*, 433.
audax, *Cam.*, 434.
aureosericeus, *Guér.*, 433.
Autolycus, *Bingh.* *, 432, 445.
bellicosus, *Smith*, 433.
Elizabethæ, *Bingh.*, 433, 434.
fenestratus, *Smith*, 434.
funestus, *Cam.*, 434.
geminus, *Bingh.* *, 436.
grassator, *Bingh.* *, 436.
hercules, *Cam.*, 433.
Juno, *Cam.*, 435.
Nicevillii, *Bingh.*, 435.
placidus, *Bingh.* *, 437.
prodigiosa, *Gerst.*, 433.
satelles, *Bingh.* *, 433, 437, 445.
serripes, *Dahlbom*, 436.
terrenus, *Bingh.* *, 435, 445.
valentulus, *Bingh.* *, 434.
venatorius, *Bingh.* *, 437, 445.
(Hemipepsis) prodigiosa, *Gerst.*, 433.
Salmo salar, 589.
Salmonidæ, 530, 550, 588.
Scapholeberis, 5, 10, 11, 12, 15, 16, 17.
mucronata, *O. F. M.*, 5, 13, 19.
Scarabæidæ, 287.
Scarabæus isidis, *Casteln.*, 287.
Scelio, *Latr.*, 218.
Sceliomorpha, *Ashm.*, 218.
Scelioninæ, 200.
Schistocerca, 281.
ægyptia, *Linn.*, 280, 281.
peregrina, *Oliv.*, 280, 281.
Schizonotus, 41.
Schizoretepora, 257.
Sclerodermi, 530, 578, 594.
Scolia, *Fabr.*, 423.
decorata, *Burm.*, 424.
desidiosa, *Bingh.* *, 424.
floridula, *Bingh.* *, 425.
histrionica, *Fabr.*, 424.
sikkimensis, *Bingh.* *, 423, 425.
Scolia vestita, *Klug*, 283.
Scoliidæ, 280, 283.
Scolopendra Balfouri, *Pocock*, 297, 298.
deserticola, *Pocock*, 297.
persica, *Pocock*, 297.
truncaticeps, *Pocock*, 297.
valida, *Luc.*, 297.
Scolopendridæ, 297.
Scomber, 594, 595, 598.
scomber, 567, 595.
Scombridæ, 530, 567, 593, 598.
Scorpions, Abdominal Appendages and Respiratory Organs in, 40.
——, Post-oral Thoracic Appendages in, 37–38.
——, Supplementary Note upon the, obtained in Egypt and the Soudan by Dr. John Anderson, 299.
—— obtained by Colonel Yerbury at Aden in the Spring of 1895 (R. I. Pocock), 316.
Scourfield, D. J., Entomostraca and the Surface-film of Water, 1–19.
Scrupocellaria, 267.
Scyllium, egg-cases of, 325.
Selenops ægyptiacus, *Sav.*, 296.
Sharks, On the Egg-cases of some Port Jackson, by E. R. Waite, 325–329.
Siluridæ, 530, 550, 590, 591, 597.
Simocephalus, 2.
Siphonostoma, 594.
typhle, 578.
Slimonia, 36, 276.
Smicra *dorsivittata*, Cam., 79.
femorata, Fabr., 79.
fulvescens, Walk., 79.
nigropicta, Cress., 79.
subpunctata, Walk., 79.
Snakes, Opisthoglyphous, On two little-known, by G. S. West, 419–422.
Solenaspis, *Ashm.*, 58, 78.
bifoveolata, *Cr.*, 58, 78.
rufipes, *Cr.*, 78.
Solifugæ, 47.
Spalangia, *Latr.*, 59.
drosophilæ, *Ashm.*, 59.
nigra, *Latr.*, 59.
Spalangiinæ, 59.
Sparasion, *Jurine*, 218.
Sparassus Walckenaerii, *Sav.*, 296.
Sparatta, *Serv.*, 526.
apicalis, *Kirby* *, 526, 529.
Bormansi, *Kirby* *, 528.
Clarkii, *Kirby* *, 526, 527, 528, 529.
pelvimetra, *Serv.*, 526, 527.
——, var. rufina, 528.
pygidiata, *Kirby* *, 527, 528, 529.

Sparatta rufina, *Stål*, 527.
Schotti, *Dohrn*, 527, 528.
semirufa, *Kirby* *, 528, 529.
Sparidæ, 530, 566, 593, 598, 599.
Spathiinæ, 58, 114.
Specific Characters, A. R. Wallace on, 481–496.
Sphæroidina Parisiensis, ftnote 500.
Sphegigastrides, 155.
Sphex *punctata*, Fabr., 79.
Sphingolabis, *De Bormans*, 529.
Erichsoni, *Dohrn*, 529.
subaptera, *Kirby*, 529.
variegata, *Kirby*, 529.
Sphingonotus nebulosus, *Fisch.*, 280, 281.
Sphyræna, 592, 594.
Commersonii, 569, 602.
Sphyrænidæ, 530, 569, 592, 599.
Spilochalcis, *Thomson*, 59, 79.
femoratus, *Fabr.*, 59, 79.
fulvescens, *Walk.*, 59, 79.
misturatus, *How.* *, 80.
nigritus, *How.* *, 79.
torvina, *Cresson*, 80.
Spilomicrus, *Westw.*, 243, 246.
aneurus, *Ashm.* *, 246.
vulgaris, *Ashm.* *, 246, 247.
Spinning-Glands in *Phrynus* (H. M. Bernard), 272–278.
Spintherus, *Thomson*, 159.
dubius, *Ashm.* *, 159.
Spirostreptus arabs, *Pocock* *, 298, 299.
Spyrathus, 288.
Squamulina, *Schultze*, 321.
scopula, *Carter*, 321.
Stenomalus, *Thomson*, 60.
muscarum, *Walk.*, 60.
Stenomesius, *Westw.*, 60, 106.
platynotæ, *How.*, 60, 106.
Stenophasmus, *Smith*, 58, 114.
pusillus, *Cr.*, 58.
terminalis, *Ashm.* *, 114.
Sternolophus solieri, *Casteln.*, 287.
Stilbum cyanurum, *Forst.*, 280, 282.
——, var. amethystinum, *Fabr.*, 280.
Strophoconus acanthopus, ftnote 500.
Hemprichii, ftnote 500.
laxus, ftnote 500.
ovum, ftnote 500.
spicula, ftnote 500.
stiliger, ftnote 500.
Stylomerus, 36.
Sudis, 55.
Swinhoe, Col. Chas., On Mimicry in Butterflies of the Genus *Hypolimnas*, 339–348.
Sympiesis, *Förster*, 166.
Syngnathidæ, 530, 578, 594.
Synopeas, *Förster*, 239.
dubius, *Ashm.* *, 239.
Syntomaspis, *Förster*, 154.
punctifrons, *Ashm.* *, 154.
Syntomosphyrum, *Förster*, 179, 181.
insularis, *Ashm.* *, 181.
Systole, *Walk.*, 146.
abnormis, *Walk.*, 146.

Tagalina, 521.
Tarantula pumilis, *C. L. Koch*, 38.
tessellata, *Pocock*, 272, 278.
Technitella, 321.
Teleasini, 213.
Telenomus, *Hal.*, 201.
confusus, *Ashm.* *, 201, 204.
cubiceps, *Ashm.* *, 202, 203, 206.
difformis, *Ashm.* *, 202, 203, 205.
flavicornis, *Ashm.* *, 202, 203, 210.
flavopetiolatus, *Ashm.* *, 202, 203, 207.
fuscipennis, *Ashm.* *, 203, 210.
impressus, *Ashm.* *, 202, 203, 204.
magniclavus, *Ashm.* *, 202, 203, 205.
medius, *Ashm.* *, 202, 207.
megacephalus, *Ashm.* *, 203, 212.
meridionalis, *Ashm.* *, 202, 208.
monilicornis, *Ashm.* *, 203.
nigrocoxalis, *Ashm.* *, 202, 211.
pectoralis, *Ashm.* *, 203, 206.
pygmæus, *Ashm.* *, 202, 208.
Sancti-Vincenti, *Ashm.* *, 202, 203, 211.
scaber, *Ashm.* *, 202, 208.
Smithii, *Ashm.* *, 202, 203, 209.
Teleosts and Ganoids, The Mesial Fins of, by Prof. T. W. Bridge, 530–602.
Temnopterus spinipennis, *Gory*, 287.
Tenebrionidæ, 288.
Tentyria orbiculata, *Fabr.*, var. glabra, *Sol.*?, 289.
sp., 289.
Termitidæ, 280, 282.
Testæ incertæ sedis, *Terquem*, 512.
Tetranychus, 275.
Tetrarhapta, *Förster*, 69.
rufipes, *Ashm.* *, 69.
Tetrastichinæ, 178.
Tetrastichodes, *Ashm.*, 181.
cupreus, *Ashm.* *, 182.
femoratus, *Ashm.* *, 182, 183.
Tetrastichus, *Hal.*, 178, 183, 187.
acutipennis, *Ashm.* *, 184, 186.
basilaris, *Ashm.* *, 184, 186.
cupreus, *Ashm.* *, 183, 184.
fasciatus, *Ashm.* *, 184, 187.
longicornis, *Ashm.* *, 184, 185.
punctifrons, *Ashm.* *, 184, 187.

Tetrastichus vulgaris, *Ashm.* *, 183, 185.
Tetrodon, 594.
immaculatus, 581, 602.
Thelyphonus, Anatomy of (M. Laurie), 20–37, 41–44, 274–278.
Thoracantha furcata, *Hal.*, 84,
Thriptera crinita, *Klug*, 290.
Thylacinus, dentition of, 459.
Tims, Dr. H. W. Marett, On the Tooth-genesis in the Canidæ, 445–480.
Tinca tinca, 549.
Tiphia collaris, Coqueb., 283.
Tooth-genesis in the Canidæ, by Dr. H. W. Marett Tims, 445–480.
Toryminæ, 152.
Torymus, *Dalm.*, 153.
pallidipes, *Ashm.* *, 153.
rugosipunctatus, *Ashm.* *, 153.
Toxoneura, *Say*, 132.
atricornis, *Ashm.* *, 132.
Toxoneurinæ, 132.
Trachypteridæ, 530, 577, 593, 594.
Triarthrus, ftnote 277.
Trichacis, *Förster*, 240.
rubicola, *Ashm.*, 240.
Trichopria, *Ashm.*, 251.
atriceps, *Ashm.* *, 251, 252, 253.
insularis, *Ashm.* *, 251, 252.
pleuralis, *Ashm.* *, 251, 252.
Trichoptera, On Segmentally disposed Thoracic Glands in the Larvæ of the, by Prof. G. Gilson, 407–412.
Tridyminæ, 154.
Tridymus, *Ratzeb.*, 154.
solitarius, *Ashm.* *, 154.
Trigla gurnardus, 571, 602.
Trigonia, 325.
Trissolcus, *Ashm.*, 212.
laticeps, *Ashm.* *, 212.
Tropidonotus natrix, ftnote 323.
Tropidopria, *Ashm.*, 249.
nigriceps, *Ashm.* *, 249, 250.
pallida, *Ashm.* *, 249, 250.
triangularis, *Ashm.* *, 249.
Tropidopsis, *Ashm.*, 245.
clavata, *Ashm.* *, 245.
Truncatulina lobatula, 320.
refulgens, *Montf.*, 320.
Tryphoninæ, 141.
Tubuli læves, lucido-candidi, ramulosi, etc., *Soldani*, 512.

Umbrella-ant, 406.
Undina, 588.
gulo, *Egerton*, 588.
Ursidæ, dentition of, 461, 463.
Utility, The Problem of: Are Specific Characters always or generally Useful? by A. R. Wallace, 481–496.

Vaginulina obscura, ftnote 500.
paradoxa, ftnote 500.
Vibraculina, ftnote 267.
Conti, *Neviani*, ftnote 267.
Vieta, sp., 290.
Viverrinæ, 463, 469.

Waite, E. R., On the Egg-cases of some Port Jackson Sharks, 325–329.
Wallace, A. R., The Problem of Utility: Are Specific Characters always or generally Useful?, 481–496.
Waters, A. W., On Mediterranean and New Zealand Reteporæ, and a Fenestrate Bryozoa, 255–271.
Webbina, 321.
West, G. S., On a new Species of *Distomum*, 322–324.
——, On two little-known Opisthoglyphous Snakes, 419–422.
Whirligig-beetles (Gyrinus), 14.

Yerbury, Colonel, List of Scorpions obtained at Aden in the Spring of 1895 by (R. I. Pocock), 316.

Zamenis viridiflavus, *Lacép.*, 323.
Zophosis sp., 288.

END OF THE TWENTY-FIFTH VOLUME.

PRINTED BY TAYLOR AND FRANCIS, RED LION COURT, FLEET STREET.